CONSEIL PERMANENT INTERNATIONAL POUR
L'EXPLORATION DE LA MER
CHARLOTTENLUND SLOT – DANEMARK

ANNALES BIOLOGIQUES

VOLUME NO. I

1839 60

RÉDIGÉ PAR
H. BLEGVAD

1939—41

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Prix: Kr. 10.00

Octobre 1943

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PREFACE

THROUGH the forty years' existence of the International Council for the Exploration of the Sea the principal object of its investigations has been the study of those marine animal populations which, by their annual renewal and growth, support the great fisheries of northern Europe. To a very great extent this study in marine biology has been built up on the ideas and methods which the science of population has created for the study of human communities.

In the study of human activity at sea it soon became evident that the industries which we call hunting and fishing do not depend merely on changes or fluctuations in the number of hunters or fishermen but also on the fluctuating magnitude of the stock of living organisms on which their activity is based. The problem of the investigation, therefore, in each case will be concerned with the relationship between two different populations and their conditions of life. On one hand, there is the human population of hunters or fishermen, on the other, the stock or "population" of living organisms, and in the comprehensive study of both these populations, their growth or decline, lies the most important task of the application of the practical biological science to the understanding of the human activities on the sea.

The approach to these studies was made by means of the hypothesis, which at the beginning seemed so daring, but which, to an increasing degree, has proved very fertile, that the statistics of the catches of the fishermen or research vessels may be considered as representative of the existing stock of those species of fish of which the catches are composed. As a problem or method the application of this hypothesis obtained a considerably enhanced importance, since the means were found for determining ages by the study of growth-zones in different organs of the fish, bones, scales or otoliths. By this means the catches could be made to yield representative information concerning fluctuations or changes in the number and size of the individuals belonging to the fish populations.

For this purpose the catches would have to be analysed into their composition of year-classes for each of the species. By this idea a comparative study of samples collected through a series of years disclosed the important fact of fluctuations in the stock from the one year to the other. These fluctuations of year-classes have increasingly revealed the changes in the composition as well as in the magnitude of the marine populations of organisms from year to year. And from the closer understanding of these changes arose the conviction that such changes were governed by laws, governed by the influence of the environment which might be investigated not only for a rational understanding of the contemporary situation but also for prognoses as to events in future. From series of investigations along these lines, continued through long periods of years, such prognoses were found to be confirmed by experience. In a continued series of years, therefore, the work found its experimental verification.

Most convincing were the results of investigations carried out during the great war, 1914—1918, when fishing activities were greatly reduced in all areas of northern Europe with the result that the stock of the most important food-fishes during these years to a great extent increased in numbers. During the years of the reduced fishing there also was an increase in the rate of growth. So impressive was this experience that the proposals for protective measures for the safeguarding of the most important species of fish, which scientists had advocated through many years, at last obtained the long expected support by the practical industry as well as by the governments participating in the international cooperation for the study of the sea. At a meeting which was held in London in the month of March 1937 delegates from 14 countries agreed on proposals for the regulation of the fishing industry by rules for a minimum size of trawl-meshes and minimum sizes of young-fish to be landed in all European markets. By these regulations it was hoped to protect the annual renewal of the stocks of all those species of fish which support the fisheries on the international high seas. From the understanding that such measures would have to be coordinated with changing events and experience within the industry the proposal was also accepted that a permanent International Commission should be organized for the purpose of the control, development and adaption of agreed regulations to circumstances in the different areas of the sea.

But succeeding years did not favour an official cooperation along these lines. At the last meeting of the International Council in Berlin, in May 1939, it appeared to be hopeless to advance any proposals for the organization of the proposed commission. Scientific delegates and experts were, however, still convinced that it would be in the interest of the industries of all countries to prepare the material, which would be needed by the proposed commission and all considerations of the problems it were intended to represent. There was therefore a general wish, that the scientific results of the study of marine populations should be reorganized and given the most appropriate form for this purpose. In all the Area Committees and in the joint Consultative Committee of the Council the planning of such an organization of the work was discussed. As a result of these discussions it was decided to collect all results of importance for the understanding of the fluctuations in the marine populations as well as their conditions of existence and changes in a special publication, for which the name "*Annales Biologiques*" was adopted. Of great value were the reviews of the arguments and views which were considered of importance for this plan and which were given in the summaries by the Chairman of the Consultative Committee, Dr. E. S. Russell (Rapp. et Proc.-Verb., Vol. No. 109, I, pp. 31—32) and by the Committee's Vice-Chairman, Professor A. Hagmeier (ibid., Vol. No. 110, pp. 107—112). The International Council is also much indepted to the authors who, under the present difficult circumstances, have made the great effort to give their contributions to the first volume of this series. In the first instance I beg to express the Council's gratitude to Dr. H. Blegvad who has acted as the editor and organizer of this first advance toward a most important object of the work of the International Council.

Johan Hjort.

Deutscher Text.

EINLEITUNG

WÄHREND des 40 jährigen Bestehens der Internationalen Meeresforschung hat die wesentliche Aufgabe ihrer Untersuchungen darin bestanden, die Bevölkerungen derjenigen Seetiere zu erforschen, die jedes Jahr durch Nachwuchs und Wachstum das Bestehen der grossen Fischereien Nordeuropas sichern. Dieses Studium der marinen Biologie ist zum grossen Teil aufgebaut auf den Ideen und Methoden, die die Bevölkerungslehre für das Studium der menschlichen Gemeinschaften aufgestellt hat.

Bei dem Studium der menschlichen Tätigkeit auf dem Meere wurde es bald klar, dass die beiden Gewerbearten, die wir Jagd und Fischerei nennen, nicht nur auf den Veränderungen und Schwankungen in der Anzahl der Jäger und Fischer beruhen, sondern auch auf der schwankenden Grösse des Bestandes der lebenden Organismen, auf welchen ihre Tätigkeit aufgebaut ist. Das Problem der Untersuchung wird daher in jedem Einzelfalle verbunden sein mit den Beziehungen zwischen zwei verschiedenen Bevölkerungen und ihren Lebensbedingungen. Auf der einen Seite steht die menschliche Bevölkerung von Jägern und Fischern, auf der anderen der Bestand oder die "Bevölkerung" lebender Organismen, und in der umfassenden Untersuchung dieser beiden Bevölkerungen — ihres Wachstums oder ihres Verfalls — liegt die wesentliche Aufgabe von der Anwendung der praktischen biologischen Wissenschaft zum Verständnis der menschlichen Tätigkeit auf dem Meere.

Eine Annäherung an diese Untersuchungen ist gemacht worden auf Grund der Hypothese — die im Beginn so gewagt erschien, sich aber später, und zwar in wachsendem Masse, sehr fruchtbar erwies — dass die Statistik vom Fang der Fischer oder der Untersuchungsfahrzeuge bezeichnend ist für den vorhandenen Bestand der Fischarten, aus denen der Fang zusammengesetzt ist. Als Problem

Texte français.

INTRODUCTION

PENDANT les quarante années d'existence du Conseil International pour l'Exploration de la Mer, le but principal des recherches fut l'étude de la vie de ces animaux marins qui, par leur croissance et leur reproduction alimentent la pêche de l'Europe du Nord. Cette étude de la biologie marine est basée, en grande partie, sur les méthodes et les idées créées par la démographie pour l'étude des collectivités humaines.

On a bientôt pu prouver, par l'étude des travaux exécutés en mer que les industries que nous appelons la chasse et la pêche ne dépendent pas seulement des variations ou fluctuations dans le nombre des chasseurs et des pêcheurs mais aussi beaucoup des différences dans la quantité d'organismes vivants sur lesquels est basée leur industrie. Le problème des recherches dépendra, dans chaque cas, des relations entre deux populations différentes et leurs conditions de vie. D'un côté se trouve le monde des pêcheurs et des chasseurs, et, de l'autre, le stock ou la "population" d'organismes vivants; c'est dans l'étude approfondie de ces deux catégories, leur croissance ou leur déclin, qu'est la tâche la plus importante pour l'application de la science biologique pratique à la connaissance de l'activité humaine en mer.

Un rapprochement de ces études fut effectué en considération de l'hypothèse — qui d'abord semblait osée, mais qui par la suite s'est révélée d'une grande efficacité — que les statistiques obtenues par les captures de pêcheurs et des bateaux de recherches peuvent être considérées some représentant le stock existant des espèces de poissons dont se compose la pêche. Comme problème ou méthode, l'application de cette hypothèse a doublé d'importance par le fait de la découverte des moyens possibles de déterminer l'âge des poissons par l'étude des zones de croissance — en examinant les différents organes tels que: arêtes, écailles, et otolithes. Par ces

oder Methode gewann die Hypothese eine wesentlich erhöhte Bedeutung von dem Augenblick an, wo die Möglichkeit bestand, Altersbestimmungen vorzunehmen auf Grund der Untersuchung von Wachstumszonen in verschiedenen Organen der Fische, Knochen, Schuppen oder Otolithen. Hierdurch gelang es, vom Fang repräsentative Angaben zu erhalten bezüglich Schwankungen oder Veränderungen in der Anzahl und Grösse der Individuen, die den Fischbevölkerungen angehören.

Zu diesem Zweck war es erforderlich, die Fänge zu analysieren und die Zusammensetzung nach Jahresklassen innerhalb jeder Art festzustellen. Eine vergleichende Untersuchung von Proben aus einer Reihe von Jahren offenbarte die wichtige Tatsache, dass der Bestand von einem Jahre zum anderen Schwankungen unterworfen ist. Diese Schwankungen innerhalb der Jahrgänge haben mit immer grösserer Deutlichkeit die Veränderungen von Jahr zu Jahr sowohl in der Zusammensetzung wie in der Grösse der Bevölkerungen der marinen Organismen aufgedeckt. Und aus dem besseren Verständnis dieser Veränderungen erwuchs die Überzeugung, dass solche Veränderungen durch Gesetze bestimmt sind, und zwar durch den Einfluss der Umwelt; diese Gesetze kann man dann untersuchen, nicht allein zum Zweck des vollen Verständnisses der gegenwärtigen Lage, sondern auch zur Vorhersage künftiger Ereignisse. Nachdem inzwischen reihenweise Untersuchungen nach diesen Richtlinien während langer Perioden von Jahren ausgeführt worden sind, lässt sich jetzt sagen, dass die Vorhersagungen durch die Erfahrung bewiesen worden sind. In einer fortgesetzten Reihe von Jahren ist so der experimentelle Beweis für die Richtigkeit der Arbeit erbracht worden.

Die grösste Beweiskraft lag in dem Ergebnis der Untersuchungen, die während des grossen Krieges 1914—18 ausgeführt wurden, als die fischereiliche Tätigkeit in allen Gebieten Nordeuropas so sehr herabgesetzt worden war, dass der Bestand der wichtigsten Nahrungsfische während dieser Jahre zahlenmässig stark abnahm. Während dieser Jahre der verminderten Fischerei zeigte sich nämlich eine Zunahme in der Schnelligkeit des Wachstums. So einleuchtend war diese Erfahrung, dass die Vorschläge für Schonmassnahmen zur Sicherung der wichtigsten Fischarten — die die Wissenschaftler schon während vieler Jahre angeraten hatten — endlich die langerwartete Stütze bei sowohl Gewerbe wie Regierung der der internationalen Meeresforschung angeschlossenen Länder fanden. Während einer Sitzung, die im März des Jahres 1937 in London abgehalten wurde, einten sich die Vertreter von 14 Ländern über Vorschläge zur Regelung des Fischereigewerbes in der Form von Regeln für eine Mindestgrösse von Trawlmaschen und Mindestgrössen für Jungfische, die in Europas Häfen gelandet würden. Es war die Absicht, durch diese Regelungen den jährlichen Nachwuchs der Bestände aller der Fischarten, auf

procédés la pêche pouvait fournir des informat
représentatives concernant les variations dan
nombre et la taille des êtres appartenant à la f
ichthyologique.

En ce cas il faudrait analyser la capture dar
composition par classes d'âge pour chacune
espèces. Une comparaison des échantillons obt
par une suite d'expériences faites pendant
nombre d'années a prouvé que le stock subit
fluctuations d'une année à l'autre; ces fluctua
dans les classes d'âge ont de plus en plus claire
mis à jour des changements d'une année à l'a
soit dans la composition soit dans la taille d
faune marine. Et par la connaissance plus in
de ces changements surgit la conviction qu'ils
soumis à des lois gouvernées par l'influence
milieu dont l'étude peut non seulement révéle
connaissance exacte de la situation actuelle
aussi prédire les événements futurs. Les expérie
continuées pendant une longue suite d'années
prouvé la justesse de ces pronostics. Après
série continue d'années l'ouvrage a donc trouv
vérification expérimentale.

Les résultats les plus évidents sont ceux obt
par des recherches faites pendant la grande gu
1914—1918, alors que la pêche était fort ré
dans toutes les régions de l'Europe du Nord et
le nombre des plus importants poissons comest
avait beaucoup augmenté. Pendant ces années-l
observa aussi une accélération de la croissa
Cette expérience fut si évidente, que la propos
de prendre des mesures de protection pour la sa
garde des espèces de poissons les plus importa
proposition revendiquée par les hommes de sci
pendant plusieures années, obtint enfin de la
de l'industrie et des gouvernements participa
la coopération internationale pour l'étude d
mer, l'appui si longtemps attendu. Dans
assemblé réunie à Londres, en Mars 1937,
délégués de quatorze pays différents accept
unanimement la proposition de faire des réglen
pour la pêche fixant une dimension minima
mailles de filets et une dimension minima
jeunes poissons devant être débarqués dans tou
ports de l'Europe. On espérait par ces réglen
protéger le renouvellement annuel de toutes
espèces de poissons qui approvisionnent la p
internationale en pleine mer. En considérant
serait nécessaire de coordonner de telles mes
aux différents événements et aux expérience
l'industrie, on décida, à cet effet, de créer
commission internationale et permanente ayant
but de contrôler le développement et l'adaptatio
réglements adoptés, pour les circonstances, dan
différentes régions de la mer.

Mais les années qui suivirent ne favorisè
pas la coopération officielle dans ces limites.
de la dernière réunion du Conseil, à Berlin, en
1939, il parut impossible d'émettre des proposi
pour l'organisation de la commission désirée.
délégués scientifiques et des experts décidè

denen die Fischereien auf hoher See unter internationalem Recht beruhen, zu schützen. Aus dem Gedanken heraus, dass solche Massnahmen den wechselnden Ereignissen und Erfahrungen des beteiligten Gewerbes angepasst werden müssten, wurde noch ein weiterer Vorschlag angenommen, dass nämlich ein ständiger internationaler Ausschuss eingesetzt werden sollte zur Kontrolle, Entwicklung und Anpassung der vereinbarten Bestimmungen, entsprechend den Verhältnissen in den verschiedenen Gebieten der See.

Die folgenden Jahre begünstigten nicht die offizielle Zusammenarbeit innerhalb dieser Rahmen. Auf der letzten Sitzung der Internationalen Meeresforschung in Berlin im Mai 1939 schien es nicht angebracht, irgendwelche Vorschläge für die Organisation des vorgeschlagenen Ausschusses vorzulegen. Die wissenschaftlichen Delegierten und Sachverständigen waren aber dennoch davon überzeugt, dass es im Interesse der Gewerbe aller Länder sein würde, alles für den geplanten Ausschuss erforderliche Material vorzubereiten und die zu behandelnden Probleme nach allen Seiten hin zu erwägen. Es bestand daher der allgemeine Wunsch, die wissenschaftlichen Ergebnisse von den Untersuchungen der Meeresbevölkerungen neu zu erfassen und zwar in einer dem Zweck am besten entsprechenden Form. In allen Gebietsausschüssen und in dem gemeinsamen beratenden Ausschuss der Meeresforschung wurden die Pläne für eine solche Ordnung der Arbeit erwogen. Es wurde schliesslich beschlossen, alle Ergebnisse von Belang für das Verständnis der Schwankungen innerhalb der Bevölkerungen der Meere sowie ihre Lebensbedingungen und Veränderungen in einer besonderen Druckschriftenserie zu sammeln, für diese wurde der Name "*Annales Biologiques*" angenommen. Von grossem Wert waren die Übersichten über die Argumente und Gesichtspunkte, die für den Plan als massgebend angesehen worden waren; diese Übersichten sind gegeben in den Zusammenstellungen ausgearbeitet von dem Vorsitzenden des beratenden Ausschusses, Dr. E. S. Russell (Rapp. et Proc.-Verb., Vol. No. 109, I, pp. 31—32) und von dem stellvertretenden Vorsitzenden, Professor Dr. A. Hagmeier (*ibid.*, Vol. No. 110, pp. 107—112). Die Meeresforschung ist auch denjenigen Verfassern sehr dankbar, die sich unter den herrschenden Schwierigkeiten grosse Bemühungen gemacht haben, um zu dem ersten Bande dieser Serie beizutragen. Hier möchte ich vor allem im Namen der Internationalen Meeresforschung Herrn Dr. H. Blegvad danken, der als Herausgeber dieses Heftes die Aufgabe auf sich genommen hat, diesen ersten Schritt auf einer neuen und wichtigen Bahn ihrer Tätigkeit zu leiten.

Johan Hjort.

malgré tout, dans l'intérêt des industries de tous les pays, de préparer les matériaux nécessaires pour la commission, et pour toutes les considérations des problèmes dont elle devait s'occuper. C'est pourquoi on souhaita, d'une manière générale, que les résultats scientifiques des études de la faune marine fussent réorganisés, et de la manière la mieux appropriée à cet effet. Tous les comités de secteurs et le comité consultatif discutèrent la question d'une telle organisation de l'entreprise. On décida alors de réunir tous les résultats d'importance, obtenus par l'examen des fluctuations dans la faune marine, de leurs conditions d'existence et de leurs modifications, dans une publication pour laquelle on adopta le nom d'"*Annales Biologiques*". De grande importance étaient les exposés des arguments et des avis qu'on estima utiles pour la réalisation de ce projet et qui étaient publiés dans les sommaires donnés par le président du comité consultatif, M. le Docteur E. S. Russell (Rapp. et Proc.-Verb., Vol. No. 109, I, pp. 31—32) et par le vice-président du comité, M. le Professeur A. Hagmeier (*ibid.*, Vol. No. 110, pp. 107—112). Le Conseil International est très redevable aux auteurs qui pendant les circonstances difficiles du moment ont fait de grands efforts pour contribuer à la publication du premier volume de cette série. Je voudrais, tout particulièrement, exprimer la reconnaissance du Conseil International à M. le Docteur H. Blegvad qui a édité ce volume et qui s'est chargé de guider les premiers pas de cette entreprise vers une ère importante et nouvelle.

Johan Hjort.

EDITOR'S PREAMBLE

AT the Council Meeting in Berlin, May 1939, the Consultative Committee recommended the start of a new series of publications: the "*Annales Biologiques*" containing "a summary of correlated biological and hydrographical data for each annual period 1st October to September 30th, on the lines suggested in the memorandum prepared by the Chairman (see Rapp. et Proc.-Verb., Vol. No. 109, I, App. 2, p. 31), the first volume, covering the period October 1938 to September 1939, to be laid before the Council at the meeting in 1940" (*ibid.*, p. 27).

Prior to this decision, the President, Prof. Johan Hjort, had taken the initiative to make inquiries among experts of the International Council as to the desirability and the need of such a publication; replies to a questionnaire circulated were definitely in the affirmative and various proposals as to shape and contents were suggested. At the Special Scientific Meeting at the beginning of the said Berlin Meeting the above-mentioned memorandum by Dr. E. S. Russell was presented and the discussion was opened by Professor A. Hagmeier by reading a paper on "Die Bedeutung des 'Ökologischen Jahresberichtes' für die Arbeiten der Internationalen Meeresforschung" containing a detailed proposal for the contents of the publication (see Rapp. et Proc.-Verb., Vol. No. 110, pp. 108—112). During the discussion following the idea of an annual report was unanimously adopted and the chairmen of committees were asked to discuss the plan in detail in their several committees (see Rapp. et Proc.-Verb., Vol. No. 109, I, p. 24).

The committees' discussions being finished and the publication meeting with unanimous approval, the above-mentioned recommendation by the Consultative Committee was edited.

According to the programme for the *Annales Biologiques* the contributions were to be compiled for each area by the chairmen who would collect and prepare the data from their area according to the agreed scheme; the material collected was then to be discussed by the committees and the Council at the next meeting.

This plan it has not been possible to follow, the committees as well as the Council having been prevented from meeting since September, 1939. However, a number of valuable material being compiled, it was considered regrettable to postpone the publication indefinitely, and the Chairmen of the four Committees for the North-Eastern, North-Western, the Transition and the Baltic Areas, therefore, held an informal meeting with the President at Stockholm during March, 1940. At this meeting a recommendation concerning the *Annales Biologiques* was passed from which the following extract be cited:—

"..... Having had an opportunity — voluntarily, inofficially, and without incurring expenses to the Council — to discuss the question at a meeting in Stockholm on March 27th—28th, 1940, we have inspected the material available from the following areas: the North-Western, the North-Eastern, the Transition and the Baltic Areas.

The Chairmen of these Committees have presented such data as have been compiled and have explained how they think it possible from data available to prepare a survey of the work done during the past year. Having studied the material we are convinced that it will be furthering the matter to summarize the observations on the most important stocks of fish within these areas. We believe it to be of greater importance to publish these data than to omit doing so on account of such possible changes as may be due to a more formal standardisation. As to future attempts to change methods of presentation or to obtain greater homogeneousness, we find no objection in the fact that the first issue must be based on individual views as to the way of solving the question. Our attempt,

it is to be hoped, may form a useful base for further development of this publication.

We recommend that the reports of the Chairmen with contributions received from the four Areas be accepted for printing as the first issue of the *Annales Biologiques*, with an introduction in which it be definitely stated under what condition the publication has been commenced.

We would highly appreciate to have contributions to this issue from the Chairmen of other Area Committees than those represented at the said Meeting. Before going to press proof-prints will be sent to all Chairmen of Area Committees and to the Chairman of the Consultative Committee.

To carry out the plans we have asked Dr. H. Blegvad for the present to act as Editor of the *Annales Biologiques* and beg to express the hope that data may be sent him from other areas also.

.....

(Signed)

Johan Hjort. K. A. Andersson.
Oscar Sund. Å. Vedel Tåning. H. Blegvad."

Due to the events of April, 1940, the recommendation could not be circulated to all members of the Council as intended. When all the same I have accepted the editorship of this first issue of the *Annales Biologiques*, I am feeling the difficulties attached to this task; as to contents and shape the lines to be followed were accepted, but the contributions received were very different and some fell quite outside the frame.

Originally it was intended to limit the first issue to the period October 1938 — October 1939, but neither this line could be maintained as it was impossible — due to war conditions — to produce contributions from all areas, and neither has it been possible in all areas to undertake extensive investigations. I have preferred, therefore, to include in this first issue all contributions received except the few that were definitely outside the scope of the publication. The authors of such contributions have agreed to publication in a volume of the *Rapports et Procès-Verbaux*.

In addition to the material mentioned in the recommendation, in respect of the four northern committees, contributions have been received also from Danish, Dutch, and German authors concerning the Southern North Sea, and Norwegian contributions concerning the Salmon and Trout and the Whaling Committees.

In compiling the material I have found it most practical to arrange the contributions primarily within each area, according to country, and secondary as to item, e.g., each species has been treated separately as far as possible. In respect of the Southern North Sea only it has been possible to arrange the material according to species.

Due to existing conditions thus, the first issue of the *Annales Biologiques* has not developed into a publication as planned. The several contributions represent various ways of solving the problem that — it is true — was not finally defined, but the object was — as it will be remembered — to settle the question as to form or shape at a coming Council Meeting. This volume is now issued as a *trial one* only — an experiment to solve the problem of form in different ways. In its present shape I trust it may serve as a foundation on which it will be possible to build or — if necessary — to rebuild future issues.

I would like here to express my gratitude to all contributors as well as to Captain W. Nellemose and his staff for valuable assistance with the compilation of the material.

H. Blegvad.

Deutscher Text.

VORWORT DES HERAUSGEBERS

IN der Ratssitzung in Berlin im Mai 1939 empfahl das Consultative Committee, unter dem Titel "*Annales Biologiques*" eine neue Schriftenserie herauszugeben, die "eine Übersicht geben sollte über zusammenhängende biologische und hydrographische Beobachtungen während jeder einjährigen Periode 1. Oktober bis 30. September, nach den Richtlinien, die vorgeschlagen sind in einem Memorandum, ausgearbeitet vom Vorsitzenden (s. Rapp. et Proc.-Verb., Vol. No. 109, I, App. 2, p. 31), und dass der 1. Band den Zeitraum Oktober 1938 bis September 1939 behandeln und der Internationalen Meeresforschung in der Sitzung des Jahres 1940 vorgelegt werden sollte" (*ibid.*, p. 27).

Bevor dieser Beschluss gefasst wurde, war auf Veranlassung vom Präsidenten, Dr. Johan Hjort, untersucht worden, ob innerhalb der Internationalen Meeresforschung die Stimmung für die Herausgabe einer solchen Schrift günstig sei. Eine Vorfrage an Sachverständige und Mitglieder hatte gezeigt, dass dies der Fall sei, und verschiedene Vorschläge betreffend Form und Inhalt wurden gemacht. Während der wissenschaftlichen Sondersitzung, die die wissenschaftlichen Verhandlungen der Ratssitzung in Berlin im Mai 1939 einleitete, wurde das obengenannte Memorandum, von Dr. E. S. Russell verfasst, vorgelegt, und Professor A. Hagmeier eröffnete die Diskussion mit einem Vortrag über "die Bedeutung des 'Ökologischen Jahresberichtes' für die Arbeiten der Internationalen Meeresforschung", in dem er einen ausführlichen Vorschlag für den Inhalt der Schrift gab (s. Rapp. et Proc.-Verb., Vol No. 110, pp. 108—112). Während der anschliessenden Diskussion gewann der Gedanke eines jährlichen Berichtes allgemeinen Beifall und die Ausschuss-Vorsitzenden wurden ersucht, die Frage in ihren Ausschüssen ausführlicher zu behandeln (s. Rapp. et Proc.-Verb., Vol. No. 109, I, p. 24).

Texte français.

PRÉFACE DE L'EDITEUR

LORS de la réunion du Conseil à Berlin en Mai 1939, le Comité Consultatif proposa de commencer la publication d'une nouvelle série, appelée les "*Annales Biologiques*", contenant "un résumé de données corrélatives biologiques et hydrographiques pour chaque période annuelle du 1er Octobre au 30 Septembre, sur les points proposés dans le mémorandum préparé par le Président (v. Rapp. et Proc.-Verb., Vol. No. 109, I, App. 2, p. 31) ; le premier volume comprendrait la période Octobre 1938—Septembre 1939 et serait à soumettre au Conseil à la réunion de 1940" (*ibid.*, p. 51).

Avant cette décision, on avait déjà, par l'initiative du Président du Conseil, M. le Docteur Johan Hjort, fait des démarches pour savoir si le Conseil International était d'accord de publier un tel volume. Une circulaire envoyée aux experts et membres du Conseil prouva que les membres étaient de cet avis, et on soumit différentes propositions concernant la forme et le contenu de la publication. A la réunion spéciale scientifique qui discuta des questions scientifiques, lors de la réunion à Berlin, en Mai 1939, le mémorandum ci-dessus mentionné, rédigé par M. le Docteur E. S. Russell, fut présenté et M. le Professeur A. Hagmeier ouvrit la discussion par une conférence sur "Die Bedeutung des 'ökologischen Jahresberichtes' für die Arbeiten der Internationalen Meeresforschung", donnant un plan détaillé sur le contenu de la publication (v. Rapp. et Proc.-Verb., Vol. No. 110, pp. 108—112). Après la discussion qui suivit, l'idée d'un tel rapport eut l'approbation générale, et on pria les présidents des comités d'examiner la question en détail dans leurs comités (v. Rapp. et Proc.-Verb., Vol. No. 109, I, p. 48).

Cette examination faite et la publication approuvée de tous, le Comité Consultatif donna la déclaration ci-dessus mentionnée.

On présuma, dans le plan accepté par le Comité Consultatif, que les articles pour les *Annales*

Unter diesen Behandlungen wurde die Ausgabe der Schrift von allen Seiten empfohlen, und das Consultative Committee gab daraufhin die obenerwähnte Erklärung ab.

In dem vom Consultative Committee angenommenen Plan wird vorausgesetzt, dass die Beiträge zu den *Annales Biologiques* für jedes der Gebiete, in die der Arbeitsbezirk der Internationalen Meeresforschung eingeteilt ist, ausgearbeitet werden sollten, und dass die Ausschuss-Vorsitzenden die Beiträge sammeln und nach einem bestimmten Plan ordnen sollten. Danach sollten die Beiträge von den Ausschuss-Vorsitzenden und dem Rat bei der nächsten Sitzung behandelt werden.

Dieser Plan hat nicht verwirklicht werden können, denn seit dem 30. September 1939 haben keine Sitzungen abgehalten werden können, weder vom Rat noch von seinen Ausschüssen. Da indessen schon allerhand wertvolles Material eingegangen war und man nicht meinte, es verantworten zu können, die Veröffentlichung länger hinauszuschieben, trafen sich die Vorsitzenden der Ausschüsse: Baltic, North-Eastern, North-Western und Transition Area mit dem Präsidenten im März 1940 zu einer formlosen Sitzung in Stockholm. Bei dieser Sitzung wurde betreffend der *Annales Biologiques* ein Beschluss gefasst, von dem hierunter ein Auszug folgt.

"..... Die Unterzeichneten, die Gelegenheit hatten, freiwillig, formlos und ohne Kosten für die Meeresforschung diese Frage während einer Sitzung in Stockholm am 27. und 28. März 1940 zu verhandeln, haben das ihnen zugängliche Material für die folgenden Gebiete behandelt: North-Western, North-Eastern, Transition und Baltic Area.

Die Vorsitzenden dieser Gebietsausschüsse haben uns mitgeteilt, welches Material jeder von ihnen hat beschaffen können, und sie haben gezeigt, wie auf dieser Grundlage eine von ihnen ausgearbeitete Darstellung der im vergangenen Jahre ausgeführten Arbeiten geliefert werden kann. Nach reiflicher Überlegung sind wir zu dem Ergebnis gekommen, dass es nur von Vorteil sein kann, wenn die obengenannte Übersicht für diese Gebiete und ihre wichtigsten Fischbestände gegeben wird. Wir halten dafür, dass es wichtiger ist, dies Material zu veröffentlichen als es zurückzuhalten aus dem einzigen Grunde, weil möglicherweise eine mehr formelle Standardisierung Veränderungen nach sich ziehen könnte. Unserer Meinung nach sollte es für spätere Versuche, die die Darstellungsweise zu ändern oder grössere Gleichartigkeit zu erstreben wünschen, kein Hindernis bedeuten, dass im ersten Heft der Versuch zur Lösung der Aufgabe auf einer mehr individuellen Auffassung beruht. Dieser Versuch wird hoffentlich eine brauchbare Grundlage für die weitere Entwicklung dieser Schriftenreihe geben können.

Wir empfehlen, die Berichte der Vorsitzenden und die ihnen zugesandten Beiträge aus den vier Gebieten als Material für das erste Heft der *Annales Biologiques* s'occuperaient de chacun des secteu dans lesquels la région du Conseil est divisée, que les présidents des secteurs réuniraient ordonneraient les articles d'après le plan conven Ces documents seraient alors discutés à la prochai réunion par les comités des secteurs et par Conseil.

Il n'a pas été possible d'exécuter ce pla puisque ni les réunions de Comités ni celles d Conseil n'ont pu avoir lieu à partir du 30 Septemb 1939. Mais comme on avait déjà assemblé u quantité de matériaux de valeur dont il était i quiétant de retarder la publication à un aven incertain, les Présidents des Secteurs Baltiqu Nord-Est, NordOuest, et de Transition et le Présider du Conseil se réunirent librement à Stockholm e Mars 1940. A cette réunion, on adopta, concernan les *Annales Biologiques*, une recommandation d'o sont extraites les lignes suivantes:

"..... Les soussignés, qui, de leur propre g et librement, sans aucun frais pour le Conseil, o eu l'occasion de délibérer la question dans u réunion, à Stockholm, dans la période du 27—2 Mars 1940, ont examiné les matériaux procurés d secteurs suivants: Nord-Est, Nord-Ouest, Transitio et Baltique.

Les présidents des comités de ces secteurs no ont éclairés sur ce qu'ils avaient pu obtenir e matériaux et ont démontré comment, sur cette bas on peut donner un compte-rendu exact des travau faits pendant l'année écoulée. Après avoir examin la question, nous sommes convaincus de l'utilité d donner sur ces secteurs et leurs fonds importan de diverses espèces de poissons un tel compte-rend Nous croyons qu'il est plus important de publie ces matériaux que de s'en abstenir en raison d changements possibles que pourrait occasionner u standardisation plus formelle. Nous ne voyo aucun inconvénient aux futurs essais de modif cations éventuelles dans la manière d'opérer, no plus aux essais d'obtenir une plus grande homo généité dans le fait que dans le premier numér une proposition soit faite d'une interprétation plu individuelle pour la solution de la tâche. Cet effor de notre part, pourra, il faut l'espérer, donner un base fertile au développement progressif de l publication.

C'est pourquoi nous conseillons que les rapport des présidents et les documents obtenus des quatr secteurs forment les articles de fond du premie numéro des *Annales Biologiques* étant expressé ment remarqué dans l'introduction les conditions d son existence.

Nous attacherions une grande importance a fait de recevoir, aussi pour le premier numéro, de documents des présidents des comités d'autre secteurs que ceux représentés à cette réunion. Avan l'impression définitive de ce numéro, une épreuv sera adressée à tous les présidents des secteurs e aux membres du Comité Consultatif.

Pour l'exécution de ces plans, nous avons pri

Biologiques anzunehmen und in einem Vorwort ausdrücklich darauf aufmerksam zu machen, unter welchen Voraussetzungen das Heft zustande gekommen ist.

Wir würden es freudig begrüssen, wenn auch von anderen Ausschuss-Vorsitzenden als den hier anwesenden, Beiträge zu dem ersten Heft einkommen würden. Vor der endgültigen Drucklegung dieses Heftes werden allen Ausschuss-Vorsitzenden und Mitgliedern des Consultative Committee Korrekturabzüge zugesandt werden.

Um die Pläne auszuführen, haben wir Dr. H. Blegvad gebeten, vorläufig die Redaktion der *Annales Biologiques* zu übernehmen, und wir hoffen, dass ihm auch von anderer Seite Material zugesandt werden wird.

.....

(Gezeichnet)
Johan Hjort K. A. Andersson
Oscar Sund Å. Vedel Tåning
H. Blegvad."

Infolge der Ereignisse vom April 1940 konnte dieser Beschluss nicht, wie beabsichtigt, an alle Mitglieder der Internationalen Meeresforschung ausgesandt werden. Wenn ich trotzdem unter Berufung auf das oben Gesagte das Amt eines Redaktörs dieses ersten Heftes der *Annales Biologiques* übernommen habe, geschieht es in dem klaren Bewusstsein, eine schwere Aufgabe übernommen zu haben. Was Inhalt und Form betrifft, liegen ganz gewiss die obengenannten Richtlinien vor, aber das eingegangene Material war recht verschiedenartig, und ein Teil fiel ganz aus dem Rahmen heraus.

Wie erwähnt, war es im Anfang beabsichtigt, im ersten Hefte der *Annales Biologiques* die Periode Oktober 1938 bis Oktober 1939 zu behandeln, aber auch dieser Plan konnte nicht ausgeführt werden, da auf Grund der Kriegsverhältnisse nicht von allen Gebieten Beiträge beschafft werden konnten, wie auch nicht in allen Gebieten umfassende Arbeiten ausgeführt werden konnten. Ich habe es daher vorgezogen, alle die bis heute eingegangenen Beiträge, soweit sie nicht ganz aus dem Rahmen fielen, in dieses erste Heft der *Annales Biologiques* aufzunehmen. Einige wenige Abhandlungen werden hiernach mit Zustimmung der Verfasser in einem späteren Bande der *Rapports et Procès-Verbaux* gedruckt werden.

Abgesehen von den im oben wiedergegebenen Beschluss genannten Gebieten ist von dänischer, deutscher und holländischer Seite Material eingegangen zum Bericht der Südlichen Nordsee und von Norwegen zu den Lachs und Wal Ausschüssen.

Es schien mir am praktischsten, den Stoff der verschiedenen Gebiete zunächst nach dem untersuchenden Lande, danach nach dem untersuchten Gegenstand zu ordnen, sodass z. B. jede Fischart soweit angängig für sich behandelt wird. Nur im Falle der Südlichen Nordsee war es möglich, den Stoff nach Gegenständen allein zu ordnen.

M. le Dr. H. Blegvad de bien vouloir, pour le moment, remplir les fonctions de rédacteur des *Annales Biologiques*, et nous espérons que des matériaux lui seront envoyés d'autre part.

.....

(Signé)
Johan Hjort K. A. Andersson
O. Sund Å. Vedel Tåning
H. Blegvad."

A cause des événements d'Avril 1940, cette recommandation n'a pu être envoyée à tous les membres du Conseil ainsi qu'il était intentionné. Néanmoins, si j'ai pris sur moi la charge de rédacteur de ce premier numéro des *Annales Biologiques*, c'est avec le sentiment de m'être chargé d'une tâche difficile. En ce qui concerne le contenu et la forme, les principales règles sont naturellement dictées ci-dessus, mais les matériaux obtenus étaient fort disparates, et plusieurs en dehors du cadre.

Comme déjà dit plus haut, le premier numéro des Annales devait traiter la période Octobre 1938 —Octobre 1939, mais ce plan n'a pas non plus pu être exécuté puisque les conditions de guerre empêchèrent la livraison des documents et aussi l'accès aux travaux attenants. C'est pourquoi j'ai préféré insérer dans le premier volume présent tous les documents reçus jusqu'à ce jour aux *Annales Biologiques* et qui n'étaient pas absolument en dehors du cadre. Ces derniers, quelques uns seulement, seront imprimés, avec l'approbation des auteurs, dans un prochain numéro des *Rapports et Procès-Verbaux*.

Nous avons reçu des articles non seulement des secteurs mentionnés dans la recommandation, mais aussi du Secteur du Sud de la Mer du Nord, de la part de l'Allemagne, du Danemark, et de la Hollande, et de la Norvège on a envoyé des papiers aux Comités du Saumon et de la Baleine.

J'ai trouvé plus pratique d'ordonner la matière pour chaque secteur, premièrement d'après les pays, d'où les recherches sont effectuées, ensuite d'après le sujet, ainsi que chaque espèce de poisson soit, autant que possible, traitée séparément. En ce qui concerne le Sud de la Mer du Nord seulement, il a été possible de classer la matière d'après le sujet.

Ce premier numéro des *Annales Biologiques* n'est pas, comme on le comprendra facilement, à cause des événements actuels, tout à fait l'ouvrage qu'il aurait dû être. Les documents présents sont de différents essais pour résoudre la tâche qui n'était pas non plus très strictement définie. Mais l'intention était aussi d'en discuter la forme définitive à la prochaine réunion du Conseil. Maintenant, nous publions, à la place, le présent volume, justement come un *essai*, essai qui cherchera de différentes manières à résoudre le problème. Tel qu'il est, j'espère qu'il pourra servir de base à

Dieses erste Heft der *Annales Biologiques* ist begreiflicherweise auf Grund der Verhältnisse nicht ganz das geworden, was beabsichtigt war. Die vorliegenden Beiträge sind verschiedene Versuche zur Lösung einer Aufgabe, die ganz gewiss auch nicht scharf umrissen war. Aber der Zweck war ja auch, die endgültige Form bei der nächsten Ratssitzung zu behandeln. Statt dessen wird dieses Heft als ein *Versuch* ausgesandt, und zwar ein Versuch, die gestellte Aufgabe auf verschiedene Weise zu lösen. So wie das Heft vorliegt, hoffe ich, wird es als Grundlage gebraucht werden können, auf der später weiter gebaut und die, falls erforderlich, verändert werden kann.

Zum Schluss möchte ich gerne den Herren Mitarbeitern für ihre Beiträge sowie Herrn Kapitän N e l l e m o s e und seinem Stab für wertvolle Hülfe beim Ordnen des Stoffes meinen besten Dank aussprechen.

Kopenhagen, im Juni 1943.

H. Blegvad.

son développement futur, et, si c'est nécessaire subir des modifications dans les temps à venir.

Pour finir, je désire remercier les collaborateurs qui ont envoyé les papiers ainsi que M. le Captaine W. N e l l e m o s e et son personnel pour leur aide méritoire dans l'arrangement de la matière.

Copenhague, en Juin 1943.

H. Blegvad.

North-Eastern Area.

Germany.

Grössenzusammensetzung der deutschen Kabeljau- und Schellfischanlandungen aus dem nordatlantischen Schelfgebiet während der Fangperiode 1938—39.

Von

Adolf Kotthaus,

Wesermünde, Arbeitsgemeinschaft für Fischereiforschung der Biologischen Anstalt Helgoland und der Reichsanstalt für Fischerei.

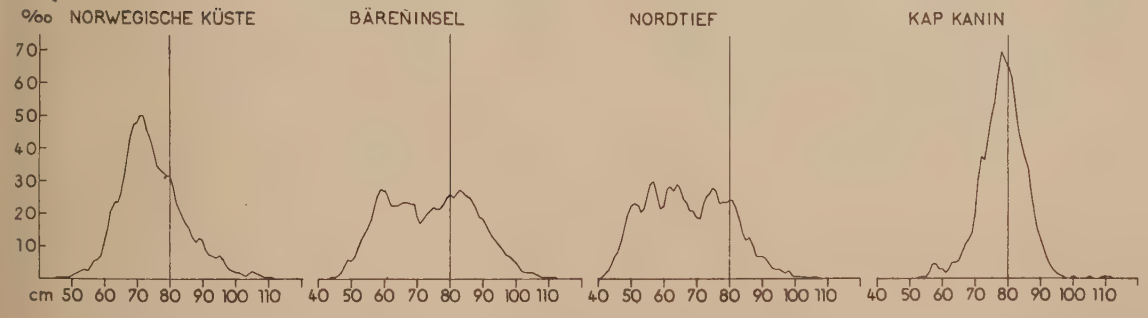

Fig. 1.

Relative Längenzusammensetzung (je Tausend) der deutschen Kabeljauanlandungen von den einzelnen Fangplätzen des nordostatlantischen Schelfgebiets.

Die Reihen sind nach der Formel

$$[(n-1)+2n+(n+1)]:4$$

geglättet. Vergleichsmaterial aus früheren Jahren bei Lundbeck, Veränderungen im arktisch-norwegischen Kabeljau- und Schellfischbestand nach Untersuchungen an den deutschen Anlandungen 1929—1939 (Rapp. et Proc.-Verb., Vol. No. 109, 3e pte, Copenhague, 1939, Abb. 1, S. 6). Bei Lundbeck Kurvenbilder statt der hier gegebenen Polygone. Lundbecks Angaben für die Fangzeit 1938/39 sind hier ergänzt durch die Beobachtungen von Winter und Frühjahr 1939, sodass das Polygon für die norwegische Küste hinzugefügt werden konnte, während die Reihen für Bäreninsel, Nordtief und Kap Kanin sich etwas geändert haben.

Folgende bezeichnenden Veränderungen gegen das Vorjahr sind hervorzuheben: Bei Kap Kanin wurde eine sehr einheitliche Gruppe mittelgrosser Fische gefangen (70—90 cm.), während kleinere und grössere Fische anteilsmässig seltener waren als im Vorjahr. Umgekehrt sind im Nordtief und bei der Bäreninsel die Kurven flacher, kleinere und grössere Fische somit relativ häufiger als im Vorjahr. An der norwegischen Küste hat der Anteil der Kabeljaus der Grösse um 70 cm., der kleinsten Fische in den Laichschwärmen, erheblich zugenommen. Dies war zu erwarten, da bereits 1936/37 kleinere Fische im Barentsmeer und bei der Bäreninsel stark hervortraten. Nach Lundbeck macht sich eine Welle junger Kabeljaus gewöhnlich in den Laichschwärmen zwei Jahre nach ihrer ersten Feststellung im Barentsmeer bemerkbar.

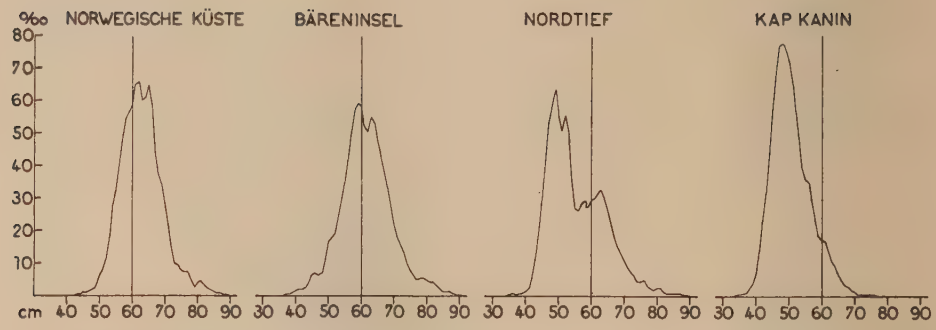

Fig. 2.

Relative Längenzusammensetzung (je Tausend) der deutschen Schellfischanlandungen von den einzelnen Fangplätzen des nordostatlantischen Schelfgebiets.

Glättung wie in Abb. 1. Vergleichsmaterial aus früheren Jahren bei L u n d b e c k (loc. cit., Abb. 2).

Folgende bezeichnenden Veränderungen gegen das Vorjahr sind hervorzuheben: Bei Kap Kanin ist nur eine einheitliche Längengruppe um 48 cm. gefangen, der zweite Kurvengipfel des Vorjahres zwischen 50 und 60 cm. ist verschwunden. Im Tiefwasser (Skolpenbank bzw. Nordtief) liegt das Längenmaximum in den beiden letzten Jahren bei 50 cm., der Nebengipfel des Vorjahres bei 58 cm. ist verschwunden, dafür sind aber grosse Fische über 60 cm. jetzt häufiger. Bei der Bäreninsel ist das Längenmaximum bei 60 cm. unverändert, die grossen Fische über 70 cm. sind aber anteilsmässig weniger geworden. Bei den Längenkurven der norwegischen Küste liegt 1938/39 bei fast gleicher Kurvenform der Längengipfel etwa um 5 cm. höher als im Vorjahre.

Hiernach scheint im Barentsmeer und bei der Bäreninsel eine neue Nachwuchswelle jüngerer Schellfische aufzutreten, die bereits 1937/38 z. T. von der Fischerei erfasst wurde, die aber in den Laichschwärmen 1938/39 noch nicht bemerkbar wurde.

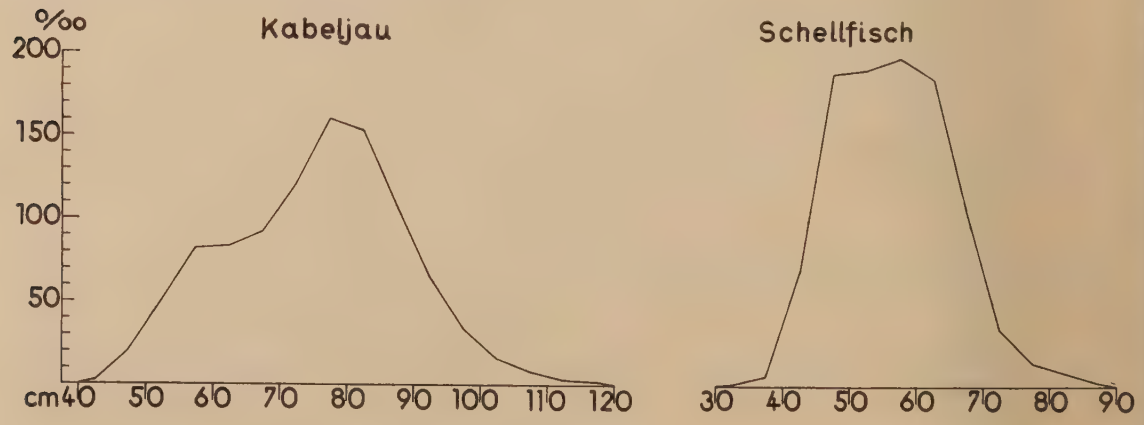

Fig. 3.

Relative Längenzusammensetzung (je Tausend) der gesamten deutschen Schellfisch- und Kabeljauanlandungen aus dem nordostatlantischen Schelfgebiet.

Ungeglättete Reihen zu 5-cm. Gruppen vereinigt. Vergleichsmaterial aus früheren Jahren bei L u n d b e c k, loc. cit., Abb. 3.

Bezeichnende Veränderungen gegen das Vorjahr: Beim Kabeljau hat sich der Hauptgipfel der Kurve von etwa 70 cm. auf etwa 80 cm. verschoben. Neben dieser Hauptmasse der Anlandungen, die aus grösseren Fischen besteht, ist ein schwacher Nebengipfel bei ca. 60 cm. neu aufgetreten. Beim Schellfisch macht sich die seit 1936/37 beobachtete Verjüngung des Bestandes nunmehr deutlich bemerkbar. Die jungen Fische (um 50 cm.) stehen anteilsmässig nicht mehr viel hinter den mittelgrossen zurück.

Norway.

Interpretation of Cod-Measurement Series by means of individual Otolith Evidence.

By

Gunnar Rollefsen.

AN account of the Norwegian cod measurements for the years 1913—33 has been given by O. S u n d in Rapp. et Proc.-Verb., Vol. No. 88, 1934.

He demonstrates the manner of dealing with the measurements and the results thereof, and shows how the results obtained from a simple method of investigation, through arithmetical operations, may give information on the conditions and fluctuations of the stock of "Skrei" or spawning oceanic cod.

Since 1932 the present author has regularly carried out investigations of individual *skrei* and the results gained along these lines have increased our knowledge of the stock.

Mass investigations, such as the measurements in question and individual investigations on age, sexual maturity, mortality, and racial characters, support each other, and results gained by means of one method should be considered along with the results obtained from the other.

The present brief account contains some results of the individual investigations and endeavours to show their importance for utilizing the material obtained from measurements.

Fig. 1 gives the length distribution of the *skrei* since 1913 up to 1940, by means of curves drawn on a constant number (10.000).

The value of each single curve depends first and foremost on its representation of the length distribution of the stock at a certain time in the annual cycle of the fish.

The value of the series of curves is contained in the alterations occurring in their shapes and positions from year to year, reflecting movements in the length distribution of the stock.

The question how these movements have come about cannot be answered by a mere inspection of the curves. Results obtained from other sources enable us, however, to draw special conclusions from specific features of the curves.

Among such specific changes in the features of the curves is the displacement of the mode. The shifting of this value is taken as an indication of fluctuations in the intensity of the recruitment. The

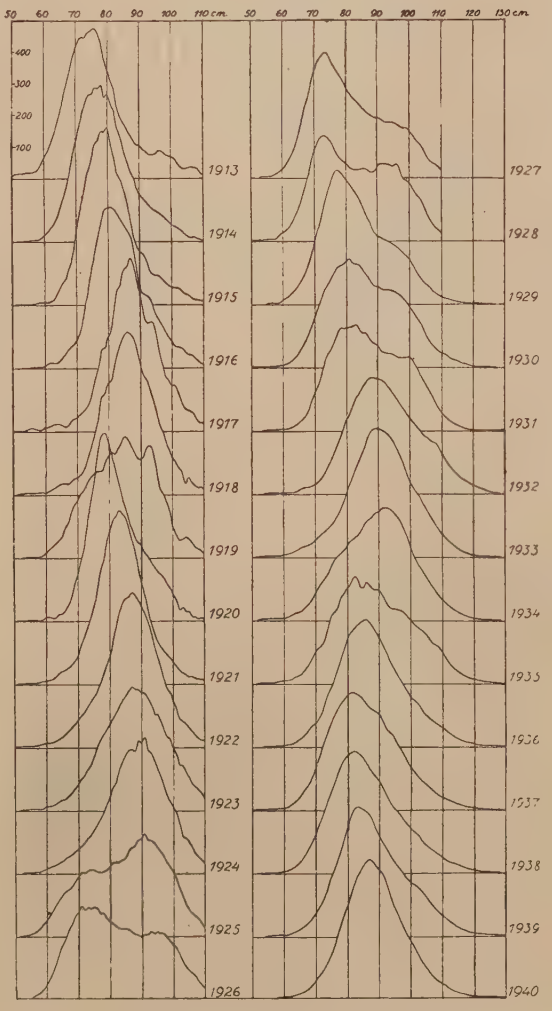

Fig. 1. Length Distribution of the Skrei.

way in which Mr. Oscar Sund has succeeded in presenting the waves of recruitment by rendering the length distributions as anomalies from an average length distribution gives us a most striking picture of the fluctuating renewal of the stock. Excesses of small fish are seen to arise and produce in the following years surplus of ever growing fish, Fig. 2.

The means of comparison in this case is the average length distribution based on measurements during 28 years. We must however take into consideration that mean values for such a period may hide features of some importance. And, in fact, we have been able to state that important fluctuations tending to smooth the average distribution have occurred.

Returning to Fig. 1, we may discuss the conditions which are giving the curves their shape and position.

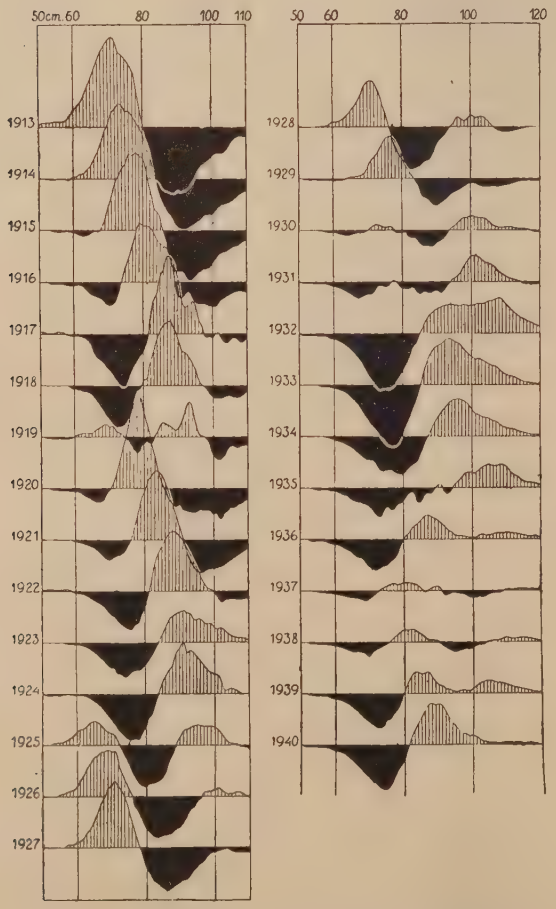

Fig. 2. Fluctuations in the Recruitment of the Stock.

The substance of our curves *is the frequency values of fish belonging to the different length groups, in casu:* centimeter-classes. Now the number of fish of different lengths depends on the following factors:

1. Extent of recruitment,
2. Growth rates,
3. Rate of mortality.

Recruitment and mortality regulate the number, and growth influences the place of the size curve, which is thus subject to modification by any or all of the three factors.

1. Recruitment. The population of cod which in Norway is called "Skrei" comprises the mature individuals of the Arcto-Norwegian Stock of Cod, the immature being termed "Loddetorsk".

The *skrei* perform extensive spawning migrations from the Barents Sea to the Norwegian coast, where the main spawning ground is the Lofoten Area. The *loddetorsk* on the contrary never migrate out of the Barents Sea, but are to be found widely spread within the borders of Northern Norway, Murmansk, Novaja Semlja and Spitsbergen.

The *skrei* are recruited from the *loddetorsk*. The ripening af a certain year-class of the *loddetorsk* has been found to cover a couple of years, following a mode similar to a Gaussian curve of distribution. Thus, a small number of fish attain maturity at an age of 6 years. The ensuing year they are followed by a larger number now of 7 years old fish.

The climax of ripening sets in between the 9th and 11th year of age, and the major part of the year-class will during these years change into *skrei*. Later on decreasing numbers will reach the state of mature fish — the late-comers reaching maturity only when 13—14 years old, in single cases not before an age of 15.

The intensity of recruitment of the *skrei* depends mainly on the strength of the ripening year-classes, but it is obvious that the mode of ripening, i. e., the proportional number of fish which will live to attain maturity each year is playing a rôle.

This number is based upon the number which theoretically ought to have been mature each year, — reduced however through mortality among the unripe and ripening fish.

Alterations in the frequency curves owing to factors regulating the recruitment are therefore influenced not only by the strength of the year-classes and the mode of ripening, but also by changes in the mode of ripening.

Our investigations have given information on the mode of ripening, mainly through the existence of spawning-zones in the otoliths. These spawning-zones have enabled us to find the age at the first spawning, and the number of earlier spawnings. We may thus classify the fish not only into age-groups, but also into spawning-groups. And in the same manner as we may determine the average

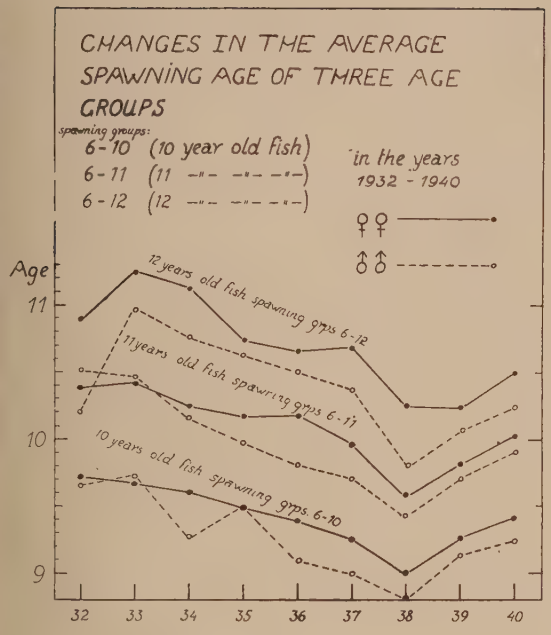
CHANGES IN THE AVERAGE SPAWNING AGE OF THREE AGE GROUPS
spawning groups:
6-10 (10 year old fish)
6-11 (11 -"- -"- -"-)
6-12 (12 -"- -"- -"-)
in the years 1932 - 1940
♀♀
♂♂
Age
12 years old fish spawning grps 6-12
11 years old fish spawning grps 6-11
10 years old fish spawning grps 6-10
11
10
9
32 33 34 35 36 37 38 39 40

Fig. 3.

age and its fluctuations we may also ascertain the average spawning age and possible alterations.

Fig. 3 gives a graphical picture of the average spawning age for 3 age-groups of *skrei* during the period 1932—1940.

In a most striking manner the average spawning age of those age-groups shows a simultaneous decrease from 1932 to 1938. From then, however, there is a tendency of increase.

From 1932 to 1938 the renewal rate of the mature stock has undergone alterations according to which the younger spawning groups have shown an ever increasing relative numerical strength.

Whether this is due to a real acceleration of the mode of ripening or/and changes in the death-rate of the young cod causing a change in the rate of influx, we are not able to ascertain on this basis.

The fact, however, that the stream of first-time spawners into the stock of *skrei* is influenced by other factors than the strength of the year-class in view should be taken into consideration when we examine the renewal of the stock apparent from our measurements and curves.

A faster rate of maturing, i. e., an accelerated influx of first-time spawners may thus give a false impression of the strength of the year-class when compared with "normal" year-classes. A slower rate of maturing will cause a delay in the renewal, and the duration of the recruitment will be prolonged. Thus, a year-class appearing small at the beginning may turn out to be of considerable strength and *vice versa*.

2. Growth.

Although the fundamental factor influencing the shape of the frequency curves is the abundance of fish of the different age-groups, possible changes in growth-rate must also be taken into consideration. The growth-rate of the cod, amounting to some 10 cm. a year in the unripe *loddetorsk* and some 3 cm. in the mature *skrei*, has however also proved to be of a variable nature. — We are namely able to demonstrate an increase of about 2 cm. per year in the growth-rate in the period 1932—36 (Fig. 4). During the last four years from 1937 to 1940, however, the changes in the average lengths of the various age-groups have shown a more irregular course, and although a decrease in the growth-rate is most likely to occur we must look upon the matter with a certain amount of caution.

As an important and very interesting fact, however, we may note that an increase in the rate of growth and a possible acceleration in the rate of ripening have taken place simultaneously.

If these two phenomena are intimately connected, i.e., if an increase in the growth-rate is the cause of an earlier attainment of maturity, we

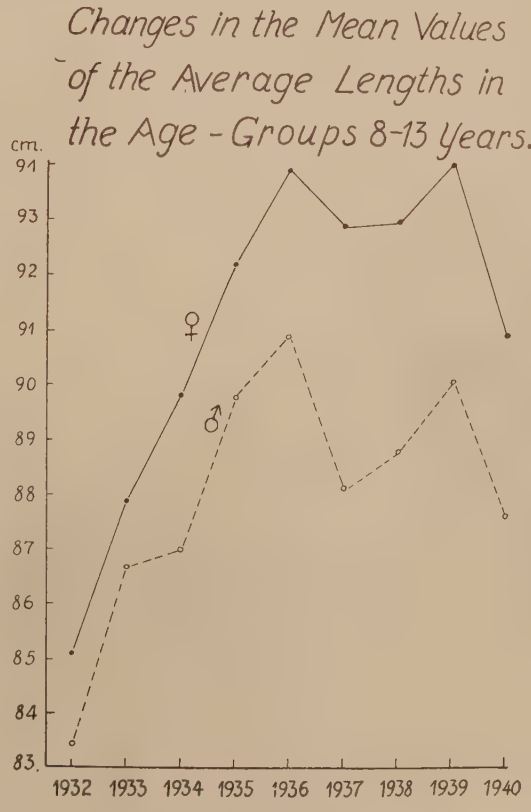

Fig. 4.

must bear in mind that an intensified influx of young first-time spawners need not neccessarily influence very heavily our curves of length distribution as the greater length attained will, of course, have a compensating effect.

3. Mortality.

As regards mortality we must in this case consider the mortality among the unripe fish and among the mature *skrei* as two separate phenomena.

The effect of the mortality among the ripening fish is not merely a reducing one upon the *loddetorsk*, it has also an effect upon the recruitment of the *skrei*. As mentioned above the maturing period of this stock of cod lasts for several years, and the death-rate of the ripening fish thus has a share in determining the initial number of young mature fish which each year are joining the stock of older spawners.

The effect of changes in the death-rate of the ripening fish has already been mentioned.

The mortality of the mature *skrei*, however, whether it is constant or variable, acts with a purely reducing effect and will tend to level our frequency curves.

Although changes in the death-rate of the *skrei* may occur, they do not seem to have been of a degree great enough to cause perceptible disturbances in the size distribution of the returning spawners. We must, however, keep in mind the heavy taxation to which the stock of cod in recent years has been subjected and the possible fluctuations in future fishing efforts.

The fragments of knowledge which have been summarized here contribute to the interpretation of the stock being pronouncedly sensitive to changes in environment.

Far from causing confusion in our conception of the fluctuations the notion of the flexibility of the stock opens the way to natural explanations of phenomena which otherwise would seem to hang in the air.

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The Stock of Skrei in 1939.

By

Gunnar Rollefsen.

IF we calculate the average yield of the Lofoten fishery for a longer period we get about 20 million fish per annum. Fig. 1 shows the yield of skrei and the number of fishermen according to the records from the fishery inspection for the years 1860 to 1939. The changes in the fishery are clearly apparent from the varying yields — from 6 to about 44 million fish. The specially rich years are 1895 and 1927—30, the specially poor ones 1864, 1900, 1911, 1913, 1917, 1918, and 1919. There is a comparatively long period both with relatively rich years — 1877 to 1897 — and with relatively poor years — 1898 to 1920. A rich-year period of such duration as that lasting from 1926 to 1932 has not occurred before.

Any direct connexion between the number of fishermen and the number of skrei caught cannot be traced. At one time, 30,000 fishermen have caught 17 million fish and at another 20,000 fishermen have caught 35 millions. Some years gave less than 400 fish per fisherman and others more than 1500.

The number of participants was certainly great in the good period 1877—97 and small in the bad period 1898—1920, but a closer examination reveals that it is the fish that increases *first* and then attracts the fisherman in the ensuing years to come to the Lofoten Islands. On the other hand, when the number of skrei decreases gradually, the number of participants falls. Consequently the

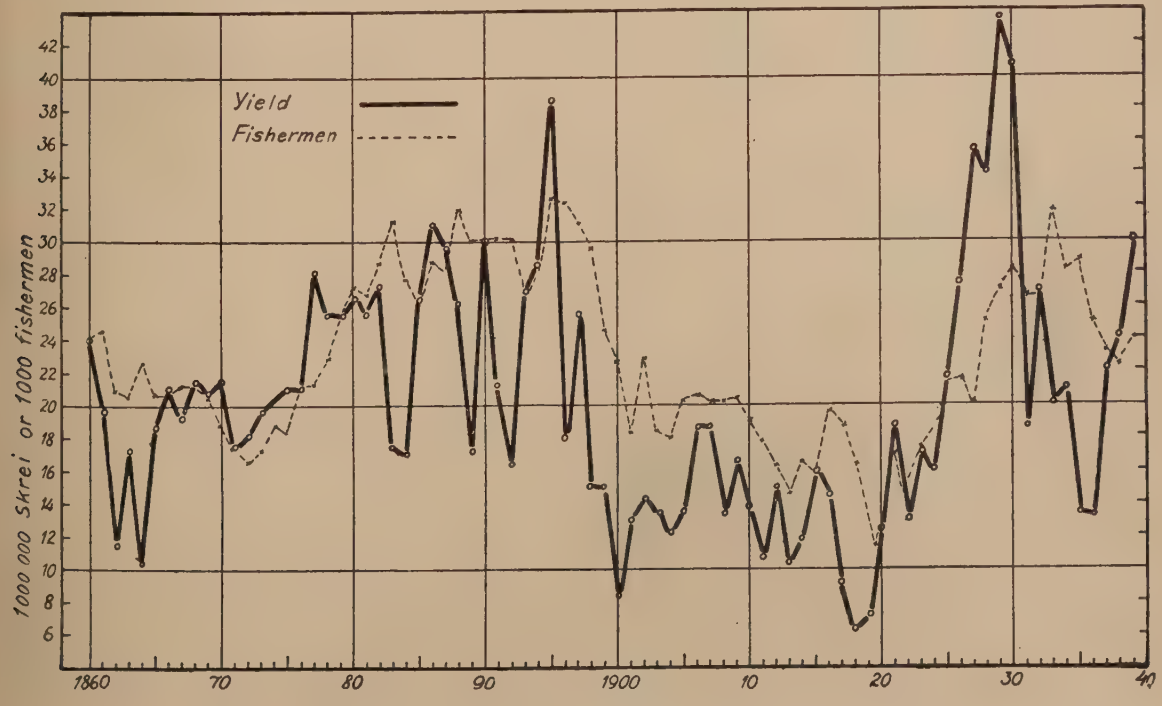


Fig. 1. Yield of Catches and Number of Fishermen at Lofoten in 1860 to 1939.

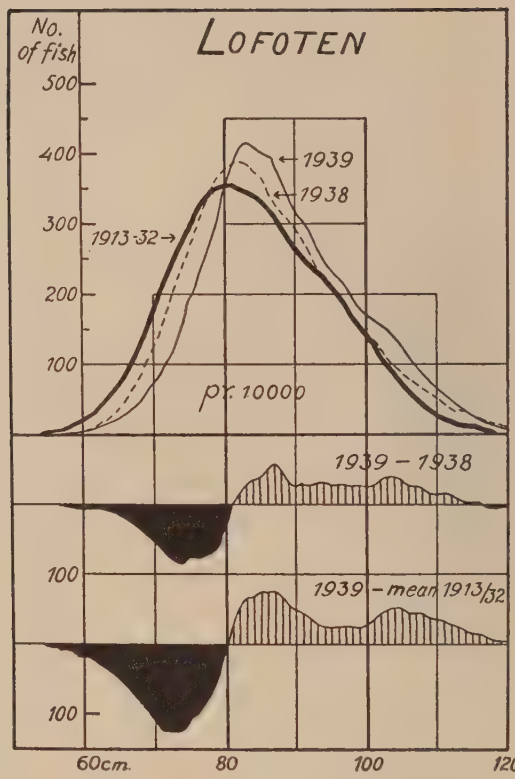


Fig. 2. The Skrei of 1939 compared with those of the preceding Year and the Average for the Period 1913—32.

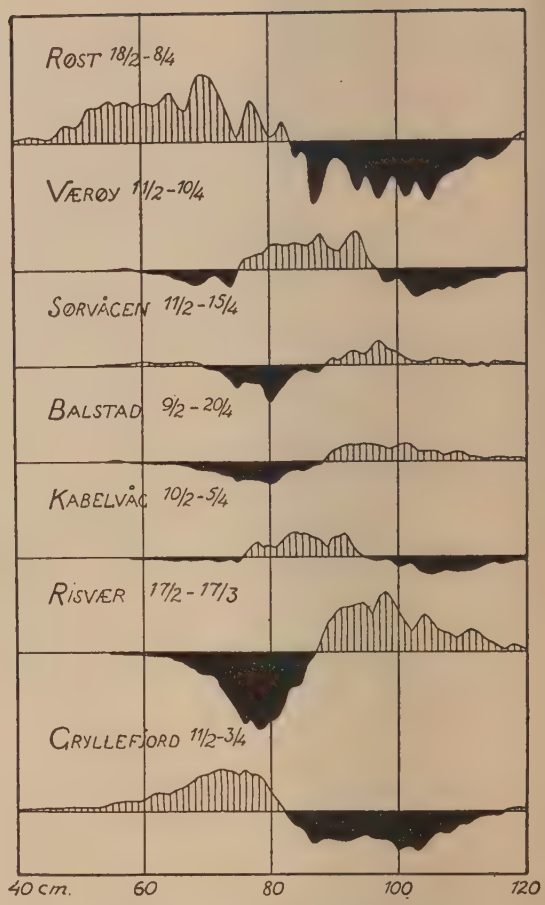


Fig. 3. Comparison of the Length of Fish at the several Stations and Average Length for the whole Lofoten Area.

fluctuations in the stock of skrei cause the great changes in the number of fishermen. There are of course variations in the number of fishermen quite apart from the number of skrei. Slack times and good times in business will influence the number of participants in the Lofoten fishery also. But the fact remains that the skrei has been subject to strong fluctuations in the period under review, and these fluctuations were not influenced by the number of fishermen.

What then are the causes of these fluctuations? Maybe the weather conditions or the way in which the fish occurs — whether it is handy for the catch, or will take the bite or goes near to the coast. Or the density of the stock may vary in different years. Let us take this possibility first.

Investigations have shown that rich and poor year-classes alternate, and it has been proved that the bad yield during the years 1917/1918 and 1919 coincided with a small stock. Between 1904 and 1912 the renewal of the stock was unsatisfactory. The 1912 year-class brought an improvement and caused increased yields in 1920 when it appeared in the catches as 8-year-old fish. After 1912 a series of rich year-classes followed, i.e., 1915, 1917, 1918, and 1919; some of them were very rich even and the result did not fail to come: 1926 to 1932 gave record returns at the Lofoten Islands.

Thereupon the yield of the Lofoten fishery decreased anew, and again the decrease coincided with a poor period of the renewal of the stock, the year-classes 1920 to 1927 being generally small. But 1937 brought an improvement, and in 1938 and 1939 the catch was above normal — due to the two rich classes 1929 and 1930.

In later years, however, twice the yield has not been in conformity with expectations: in 1931, it was only about half of what it ought to have been and in 1933 about a third greater than expected. This cannot be caused by the number of fishermen: there were 26,000 in 1931 and only 23,000 in 1937. The weather conditions of these two years, however,

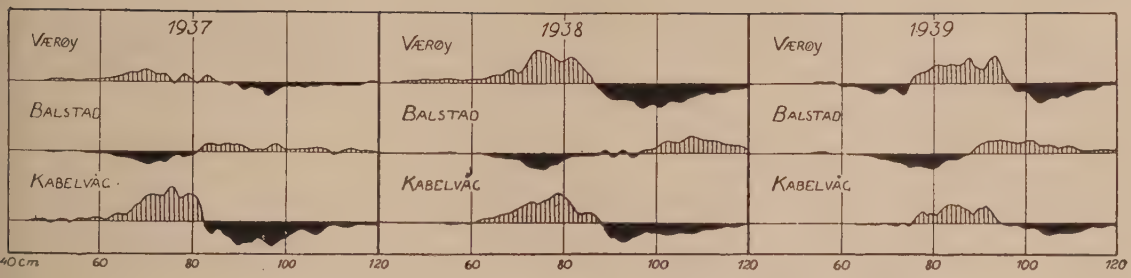


Fig. 4. Comparison of Fish at Værøy, Balstad and Kabelvåg during 1937, 38 and 39.

would seem to give a satisfactory explanation. The season of 1931 was characterized by gales and rough weather. In his report for 1931 the chairman of the Lofoten Committee says: "Apart from a good weather period in April, during the whole winter the fishery was carried out under extremely bad conditions". The season of 1937 was characterized by good weather. The chairman of the committee says: "The weather conditions as a whole must be called specially favourable for an optimal catch of the stocks present".

Of course it must not be forgotten that other causes as well may have been present, but the weather has undoubtedly been an important factor for determining the yield of the fishery during these two seasons.

Length Distribution.

As far as the yield is concerned, the season of 1939 was far above normal, the catch amounting to about 30 million fish. The fish was large (line-caught fish weighing about 3·6 kg. and net-caught fish about 4·1 kg.); the length distribution of the line-caught fish of 1939 — and that of 1938 for comparison — is given in Fig. 2. That of 1939 is considerably above that of the two previous years.

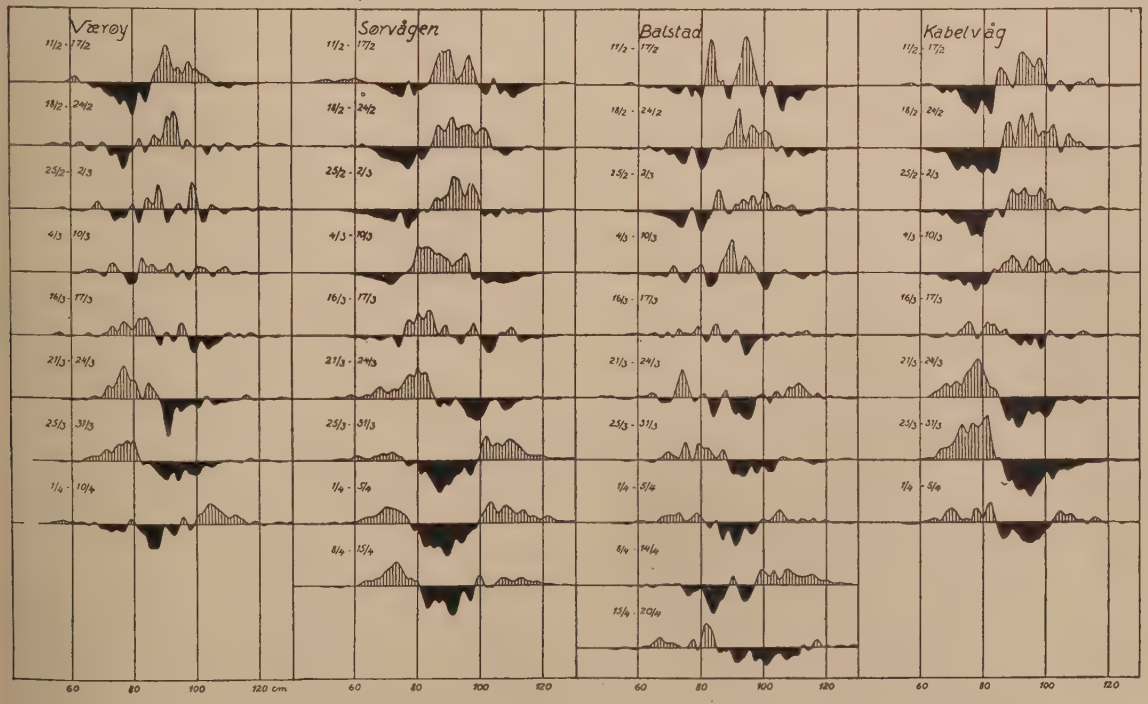


Fig. 5. The Length of the Lofot Fish in 1939.
The weekly measurements are given as deviations from the average length of the season at every station. (The plus-variations are hatched, the minus-variations black).

The average weight (according to returns from the inspection) was as follows:—

1939	1938	1937
3·8 kg.	3·75 kg.	3·62 kg.

The Length of the Fish at the several Stations.

The length of the fish at the several stations is not uniform. A comparison between the lengths at Røst, Værøy, Sørvågen, Balstad, Kabelvåg and Risvær shows great differences. As usual, the fish are largest at Risvær, next follows Balstad and then the length decreases further toward Røst etc., see Fig. 3. It is strange that Kabelvåg has smaller fish than Balstad and Risvær, but it seems to be so every year. The last three years at any rate show an evident conformity (see Fig. 4).

If we compare the length of fish from various stations for every week with their average length during the whole season we find that the length of fish has changed during the seasons and that the fish was everywhere largest at the beginnig but diminished then perceptibly. At Værøy, Sørvågen and Balstad the change occurs gradually, at Kabelvåg rather abruptly on March 15th. The change is so sudden that an advent of new fish must be supposed (see Fig. 5). It is interesting to note how the length of the fish increases towards the end of the season at Balstad, Sørvågen and Værøy. It is probably the fish from the inner parts of the Vestfjord that seek out of the fjord. Measurements of net-caught fish show that the largest fish — as usually — occur at Risvær, and then the length diminishes the farther out we proceed into the Vestfjord. just as in the case of the line-caught fish (see Fig. 6).

A figure giving the length distribution of the skrei during the last 27 years is already reproduced in an earlier paper, see Fig. 2, p. 20; each year's deviation from the average of the 28-year period 1913—40 is given by hatching for surplus and black for deficit. The years 1937 and 1938 show a somewhat minor deficit for small fish than the preceding ones — a result of the advent of the 1929 and 1930 year-classes. In 1939 the deficit has again increased because these two latter year-classes have grown to greater lengths without any new year-classes to replace them.

Age Distribution.[1])

The age distribution shows that there were two year-classes which sustained the fishery in 1939, those of 1929 and 1930. which constituted together 70 % of the stock, in other words, about 20 million

[1]) See G. Rollefsen: The Age af the Skrei, next page.

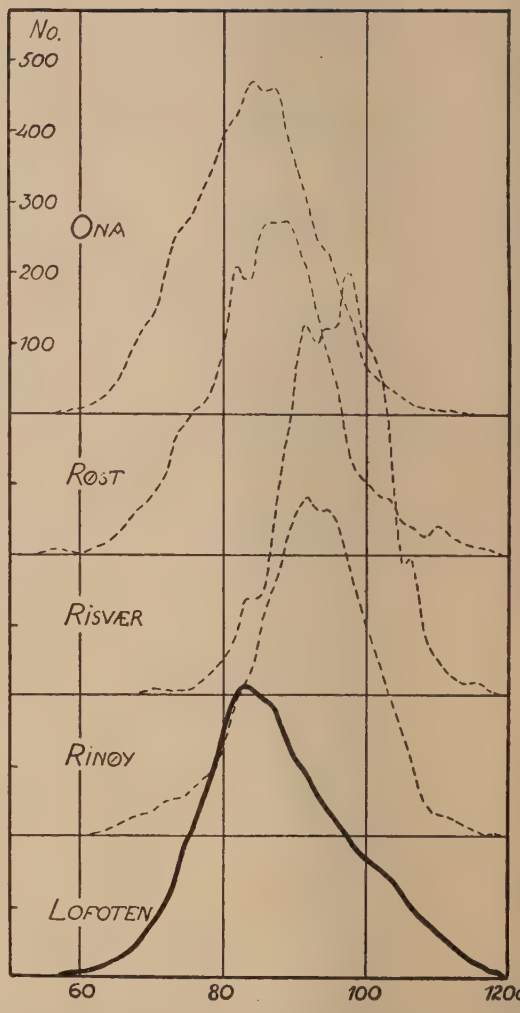


Fig. 6. Measurements of Net-Caught Fish at Lofoten, 19
The heavy curve represents the length distribution of al
measured line-caught fish at Lofoten.

of the 30 million skrei fished belonged to the two year-classes. Up to now the 1929 year-cla has provided about 24 million fish and the 19 year-class about 14 millions. In comparison t 1924 year-class — which is now practical exhausted — has not supplied more than 7 millio The 1930 year-class started somewhat weaker th the 1929 one, but has now reached about the sa size. The later year-classes — 1931 to 1933 — not promise good.

The Age of the Skrei.

By

Gunnar Rollefsen.

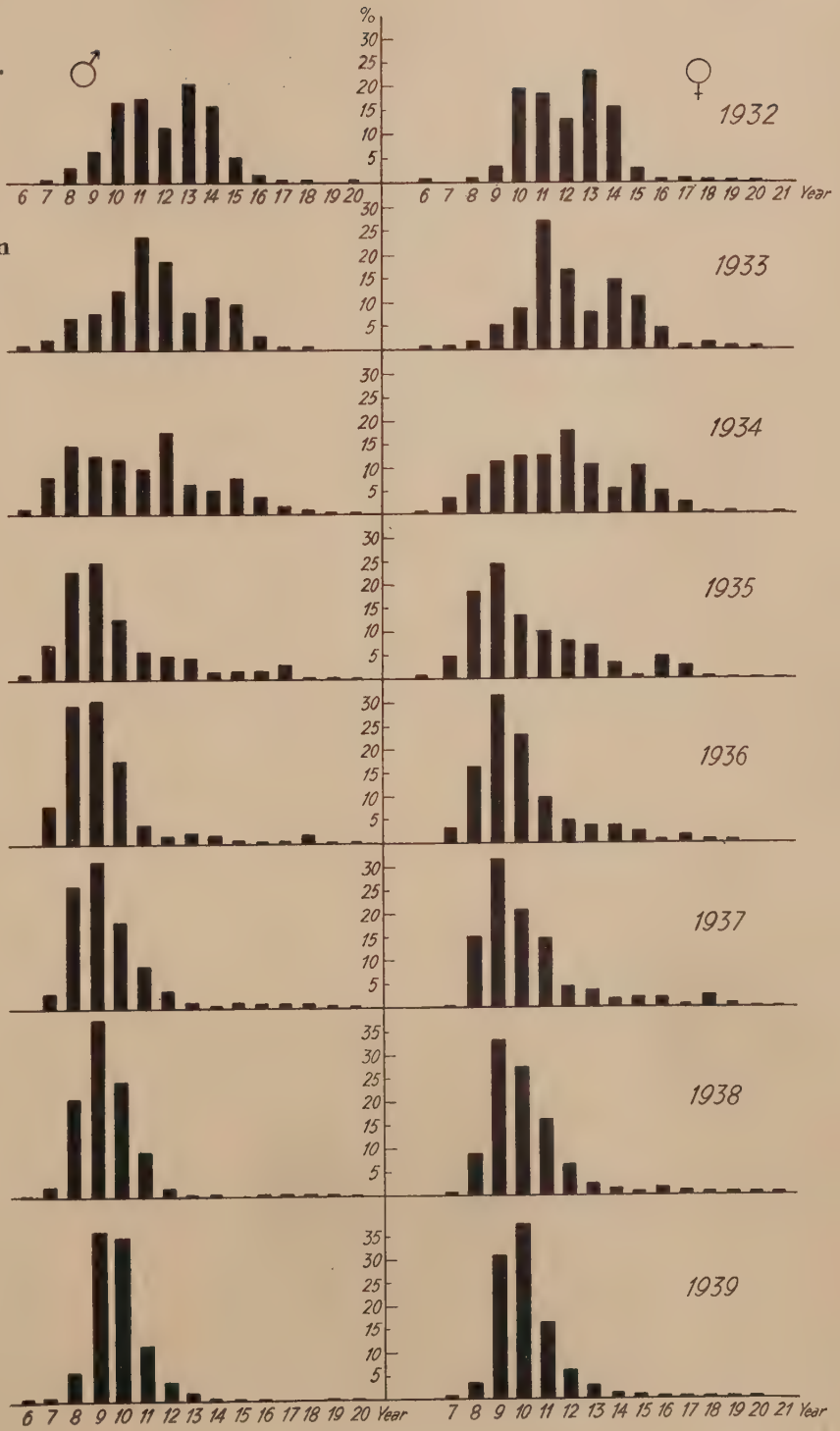
The Age-Distribution within the Arcto-Norwegian Cod Stock.

Since 1932, the age-distribution of the "Skrei" — or the spawning migratory cod — has been investigated by examining the otoliths, a method that has proved very suitable for "Skrei".

In each year of the said period a number — varying from 600 to 6000 — of otoliths has been examined, and very important results have been achieved as to renewal and mortality of the stock as well as growth of individual fish.

During this period the age-distribution has shown interesting developments; thus it will be noticed that a very considerable part of the 1932, 1933, and 1934-stocks consists of old fish of the 1918—1919 year-classes while the following 5 year-classes — 1920—1925 — provide but relatively poor recruitments. — The year-classes 1926 to 1930, again, provide increasingly better recruitments, and the stocks of recent years, therefore, consist of younger fish.

The accompanying histogram records the age distribution of male as well as female fish.



Some Data on the Plaice in Norway.

By

Finn Devold,

Norwegian Fisheries Laboratory, Bergen.

DURING the last 20 years the catch of plaice: *Pleuronectes platessa* has grown to be a fishery of economic importance also in Norway. The export of plaice has increased rapidly from 78 ton in 1922, to 4699 ton in 1932; since then the export of plaice has decreased but still reached some 2700 ton per annum during the last 3 years before the outbreak of the war.

In connexion with the artificial hatching of plaice by the Trondheim Biological Station — barring brief intervals — continued since 1908, about 1000 plaice are caught annually at Sundnes in the central part of the Trondheimfjord; the fish has been caught by Danish seine during February. Having served as mother-fish they were previously re-liberated, but since 1935 they have been examined by the author.

The **age** has been determined from the otoliths and from the right-hand inter-operculum; dealing with individuals as old as those from the Trondheimfjord it is difficult to determine the age from otoliths while the method of H e i n c k e in using the inter-operculum has proved very useful. From the material of the 5 years: 1935—1939, the following Table 1 has been prepared.

The material includes mature specimens only; the figures of the table are recorded by Fig. 1 also.

— The male individuals amounted to the followi percentages:

Year	1935	1936	1937	1938	1939
%	61·0	46·5	39·4	50·1	52·3

The 1930 year-class completely dominates t material of 1935 and 1936, and this year-cla must have been very strong. Also the 1925 yea class is well represented while the 1929, 1931, a 1933 year-classes are very poor.

The several year-classes appear at correspondi strength throughout the years, thereby indicati that the material may be considered fairly represe tative as far as the mature part of the stock concerned. It is thus evident that the differen in strength of the year-classes varies considerab among the plaice of the Trondheimfjord.

The usefulness of artificial hatching of sa water fish has been highly disputed and ag analyses do not seem to contribute positively to t discussion; in any case, the artificially hatch brood from the Trondheimfjord is in no way su ficient to smooth the natural variations of the sto of the Trondheimfjord. The stronger year-cla 1930, thus, has been predominating in spite of t fact that no fry was liberated in the Sundnes-distri

Table 1.

Age-Distribution (per mille) of Plaice caught at Sundnes, mid-Trondheimfjord.

Year of Capture		3	4	5	6	7	8	9	10	11	12	13	14	15	>15
1935	♂	55	7	827	8	4	15	15	59	4	4	—	—	4	—
	♀	—	—	443	23	23	46	35	351	17	69	11	—	6	41
1936	♂	—	242	43	638	23	14	9	5	29	—	—	—	—	—
	♀	—	84	4	581	21	18	29	27	145	22	47	6	—	18
1937	♂	433	40	267	18	214	4	4	—	—	9	—	—	—	—
	♀	8	2	147	12	524	14	18	35	6	161	2	43	14	12
1938	♂	203	640	16	72	13	41	—	3	—	—	10	2	2	—
	♀	8	237	18	165	—	405	18	18	14	12	65	2	24	14
1939	♂	40	644	258	13	19	2	22	2	—	—	—	—	—	—
	♀	—	112	248	30	126	9	340	5	14	16	7	70	2	22

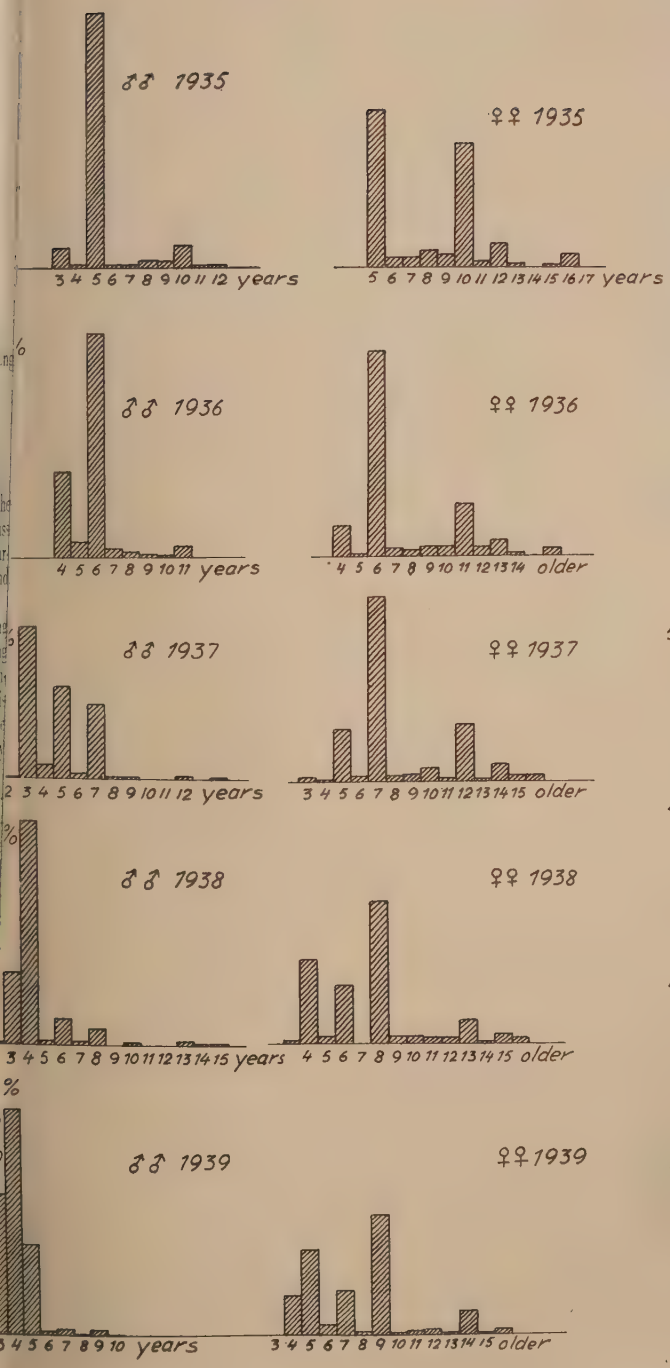


Fig. 1. Age of Plaice caught at Sundnes (mid-Trondheimfjord) in the springs of 1935—39.

in that year, and but very small quantities in other parts of the Fjord (2 mill. as against 20 mill. in other years in the middle and inner basins).

Growth. The material is insufficient for calculating average lengths for all age-groups within the samples, but some of the values recorded in tables 2 and 3 seem well founded.

The fish are measured in cm. (the 30-cm. group including all specimens measuring from 29·5 to 30·4 cm. — thus comparing internationally acknowledged measurements with Norwegian ones, ½ cm. should be added to the latter ones).

As already mentioned the samples were collected during February and killed during April after spawning within the hatchery. Thus, measures record the length prior to or near the beginning of a new growth-period, — in other words at full years of age.

Based on the material from 1935—1939 (last column of tables 2 and 3), Fig. 2, has been constructed to show the mean-length of the several year-classes for males and females

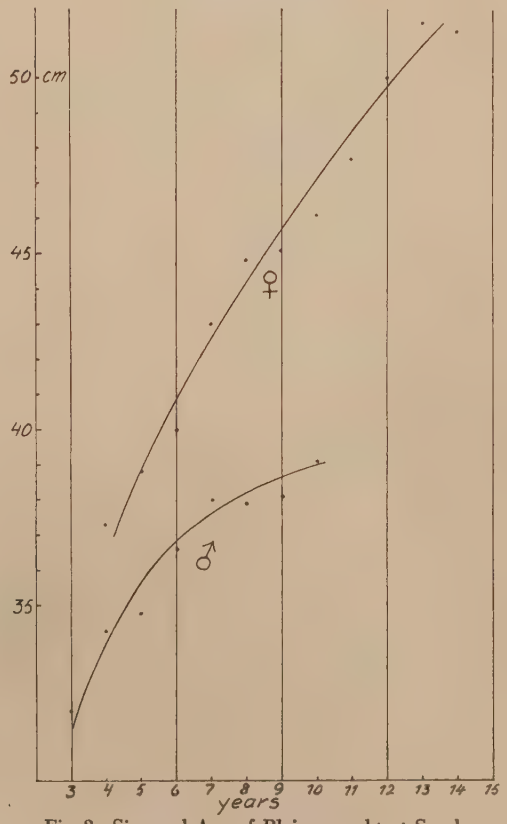


Fig. 2. Size and Age of Plaice caught at Sundnes, 1935—39 (see Tabs. 2 and 3).

separately. The figures do not follow the curves as smoothly as expected; this, however, is due to the fact that growth during the years in question has been subject to great variations. The growth of a year-class has increased during the period 1935—1938. Studying, for example, the two strong year-classes: 1925 and 1930, it will be noticed that the growth-increment of females was 1·6 and 1·8 cm. in 1935/36, but 2·7 and 3·2 cm. respectively in 1937/38. The actual growth, thus, has increased with age contrary to the general experience. As might be expected, however, the younger year-class has grown more than the older one. — Growth-conditions for plaice therefore must have improved considerably within the Trondheimfjord from 1935 to 1938. — Judging from mean-length records poorer growth-conditions must have happened again during 1938/39.

In general, the Trondheimfjord plaice record good growth; as compared to the southern North-Sea plaice the average length of the V-group in Trondheimfjord is 7—8 cm. more than the highest record for this group in the southern North Sea. According to Tåning (6) plaice from south-Icelandic waters are the only ones approaching the Tron heimfjord records of growth. Tåning conside growth of plaice in south-Icelandic waters as t highest ones ever recorded:

	3	4	5	6	7 yea
mean length	29-31	33-37	36-40	35-37	36-44 c

From his own observations as well as tho of Reibisch, A. C. Johansen (5, 191 pp. 31/32) records the following values of mea length of the several age-groups of plaice fro the Danish Belt-Sea (see Tab. 4).

Apart from the considerably higher growth the Trondheimfjord plaice, in several ways sim larities exist with the results recorded by A. Johansen. Thus:

(1) Considerable differences in growth of mal and females.

(2) Males disappear earlier than females fro the catchable stock, making it impossible to obta a total value for the average length of the enti stock.

(3) A high growth-rate at younger ages drop

Table 2.
Average Length of Male Plaice from Sundnes, mid-Trondheimfjord.

Age years	Year of Capture 1935		1936		1937		1938		1939		1935—3	
	mm.	No.	mm.	No.	mm.	No.	mm.	No.	mm.	No.	mm.	N
3	305	15	—	—	313	38	325	103	314	25	320	18
4	—	—	350	107	—	—	351	329	332	404	342	84
5	341	212	359	19	357	18	384	8	354	162	348	41
6	—	—	364	289	—	—	377	37	369	8	366	33
7	—	—	—	—	377	24	388	5	381	12	380	4
8	358	5	—	—	—	—	384	22	—	—	379	2
9	378	4	—	—	—	—	—	—	389	13	381	1
10	391	17	—	—	—	—	—	—	—	—	391	1

Table 3.
Average Length of Female Plaice from Sundnes, mid-Trondheimfjord.

Age years	Year of Capture 1935		1936		1937		1938		1939		1935—3	
	mm.	No.	mm.	No.	mm.	No.	mm.	No.	mm.	No.	mm.	No
4	—	—	378	44	—	—	375	124	364	62	373	23
5	375	78	—	—	400	21	416	10	391	141	388	25
6	—	—	393	301	—	—	424	73	408	17	400	39
7	—	—	412	13	417	61	—	—	430	75	430	14
8	424	8	445	9	—	—	449	211	430	5	448	23
9	455	6	443	16	—	—	508	9	450	198	452	22
10	456	58	447	12	—	—	475	6	463	3	462	7
11	—	—	472	74	—	—	494	7	500	7	477	8
12	—	—	499	10	494	32	518	6	481	9	500	5
13	—	—	516	25	—	—	521	36	480	4	516	6
14	—	—	—	—	533	12	—	—	504	39	514	5
15	—	—	—	—	—	—	553	13	—	—	553	1

onsiderably after reaching maturity and is steadily ecreasing with age.

According to Tåning (6) conditions are uite different in Icelandic waters in respect of t. (1) and (2): the length of males practically quals that of females at all ages, and even within he VII-group males predominate numerically in he catches.

Plaice-records from other Norwegian waters nfortunately are scarce, still some are worth tudying: (See Tab. 5.)

Average length is here recorded without separating as to sex, — the material is small but the run of the figures still permits drawing some conclusions as to growth.

Most remarkable is the high growth-rate recorded from the Söröydistrict in Finmark; considering the low temperatures in this water the growth-rate of the plaice must be considered extremely high. According to Aage J. C. Jensen (4) the growth in Danish waters increases linearly with temperature up to 15° C. — and according to the experiments by Ben Dawes (3) the lowest temperature at which growth is traceable should be 10° C. — The temperature of Revsbotn — not far east of the place where the plaice were caught — has been given in Fig. 3, the values of which are those at 4 m. depth recorded by thermographs fitted at the initiative of Oscar Sund on board 2 liners regularly serving this route and thereby supplying 4 observations per week. The full-drawn contour shows the mean temperature for the years 1936—40, the broken curve the temperature recorded during 1938, the warmest year recorded in these waters. The highest temperature at 4 m. depth rarely passes 10° C., and for one month only reaches above 9° C. At greater depths the maximum temperature is lower and the amplitude less.

When good growth in spite of the low temperature exists, this is most probably due to the plenty of food. Bjerkan (2) states that the small sandeel *(Ammodytes tobianus)* is the prime food of the plaice in great parts of northern Norway waters; during summer the plaice stomachs may be filled with small sandeels, which at certain periods appear in enormous quantities along the Finmark coast. The late maturing of plaice in these waters also may be responsible for a considerably longer good growth-period than that in more southerly stocks reaching maturity somewhat earlier.

Table 4.
Average Length of Plaice in the Belt Sea.

(Approximated figures in cm. for the years 1902—11).

Age:	1	2	3	4	5	6	7	8	9	10	years
♂	8·0	16·0	19·5	22·0	—	—	—	—	—	—	Langeland Belt
♀	8·0	16·5	20·5	24·0	26·5	27·0	28·5	30·0	31·5	33·0	
♂	8·0	16·0	19·0	20·5	21·5	22·5	23·5	24·5	—	—	S. entrance of
♀	8·0	16·5	20·5	24·0	25·5	27·0	28·0	29·0	30·0	31·0	Lille Belt
♂	8·0	16·0	18·0	19·0	20·0	21·0	22·0	23·0	—	—	Fehmern Belt
♀	8·0	16·5	20·0	22·5	24·0	25·0	26·0	27·0	28·0	29·0	
♂	7·0	14·0	17·0	18·0	19·0	20·0	21·0	22·0	—	—	Fehmern Belt —
♀	7·0	14·0	18·0	20·0	21·5	23·0	24·0	25·0	26·0	27·0	Kadetrenden

Table 5.
Average Length of Plaice in mm.

Locality	Date	Age-groups 3	4	5	6	7	8	9	10
Vigra near Ålesund	$^{31}/_{5}$ — 35	307 (32)	330 (37)	397 (16)	411 (9)	430 (2)	— —	— —	— —
Beitstadfj. Trondheimsfj.	$^{23}/_{5}$ — 35	368 (28)	396 (18)	400 (26)	390 (3)	453 (3)	462 (4)	470 (6)	513 (13)
Söröy in Finmark	$^{2}/_{8}$ — 35	— —	307 (3)	397 (21)	424 (10)	473 (8)	465 (2)	512 (2)	— —
Leirpollen in Tana, Finmark	$^{22}/_{7}$ — 35	165 (38)	219 (7)	250 (2)	264 (40)	284 (42)	291 (7)	— —	— —

NB. The figures in brackets give the numbers of fish.

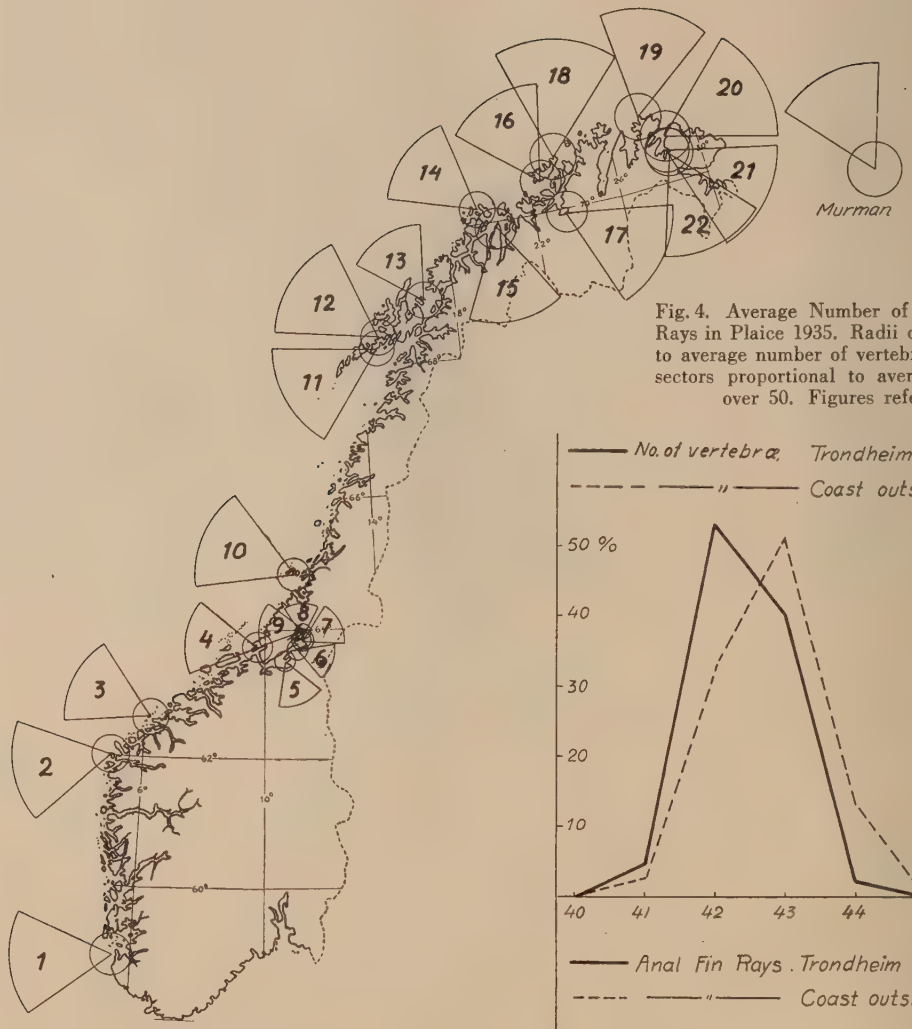
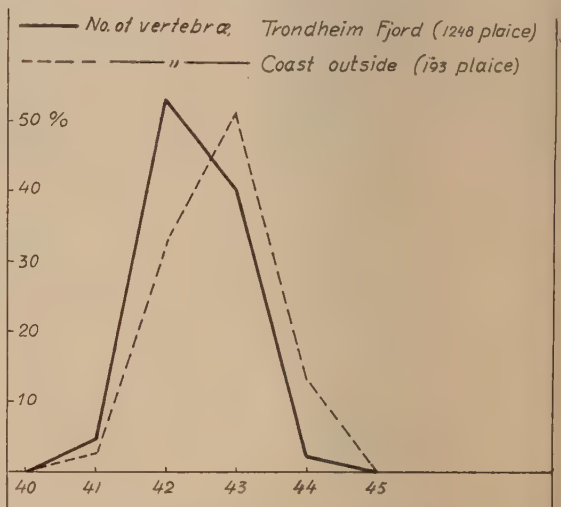
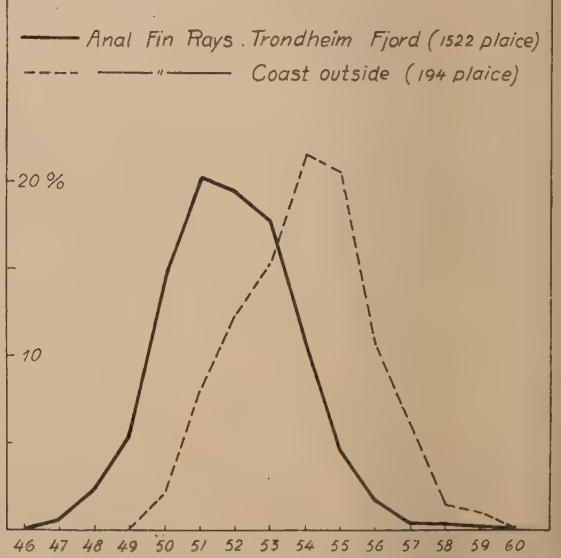


Fig. 4. Average Number of Vertebrae and Anal Rays in Plaice 1935. Radii of circles proportional to average number of vertebrae over 42. Radii of sectors proportional to average number of rays over 50. Figures refer to Table 6.





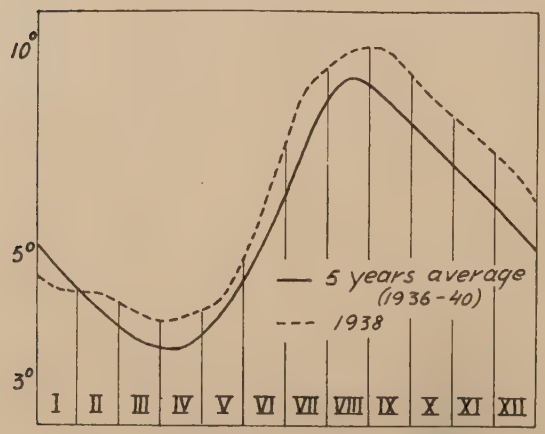


Fig. 3. Temperature at 4 m. Depth at Revsbotn (Lat. 70°51′ N., Long. 23°53′ E.).

Fig. 5.

According to Table 5, the growth should be very poor at Leirpollen (Tana). The Leirpollen is, however, a typical breeding ground where numerous plaice spend their first years of life. According to marking experiments by Bjerkan (2) the plaice then emigrate and disperse on the different plaice-banks along the coast. The difference between the mean-length of two successive year-classes, thus, is no indication as to growth. The quicker the growth the earlier does the plaice emigrate, while the slow-growing individuals remain and thus form the object of a misleading material for calculation of mean-length.

Race. Numerical values of vertebral numbers and numbers of anal-fin rays have been determined for plaice from a series of localities along the Norwegian coast. The results are recorded in Table 6 and Fig. 4.

The Trondheimfjord values are characteristic by low numbers of vertebrae as well as anal fin rays; coastal stocks show relatively high values at Jaeren, but decreasing values with increasing latitude. Barring the Trondheimfjord the values approximately keep at the same level as far north as Troms from where they again increase, going north and east as far as Tana in the Finmark. At the Murman coast Averinzev (1) records Vert. S. at 43·15 and A. at 54·69; this corresponds reasonably with the values at Finmark.

The regular variation in Vert. S.- and A.-values does not justify a division of the coastal stocks into different races, on the contrary, it indicates one race living from the North Sea to the Barents Sea. The variation may be ascribed to phaenotypic characters. A great and real difference in these morphologic characters does exist between the Trondheim plaice and that of the coastal waters. In Fig. 5 the samples 3 and 10 — from Vigra and Vikna — represent the coastal stock, the samples 5—9 the Trondheimfjord stock; the difference between the Vert. S-values of these representatives is 0·36, or 6 times the value of the "probable error" expected.

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Table 6.
Number of Vertebrae and Anal Fin Rays in 1935.

Sample No.	Locality	Date	Vert. S	A
1	Tananger, Jæren	$^{16}/_{12}$	42·92 ± 0·05	54·46 ± 0·10
2	Revika, Stadt	$^{18}/_{11}$	42·80 ± 0·03	54·29 ± 0·12
3	Vigra near Ålesund	$^{31}/_{5}$	42·77 ± 0·07	53·75 ± 0·19
4	Örlandet	$^{27}/_{5}$	42·65 ± 0·12	53·15 ± 0·43
5	Vikaleiret, Trondheimsfj.	$^{20}/_{5}$	42·44 ± 0·02	52·00 ± 0·17
6	Levanger area	$^{21}/_{5}$	42·45 ± 0·04	51·60 ± 0·18
7	Sundnes, Trondheimsfj.	$^{6}/_{5}$	42·49 ± 0·03	51·84 ± 0·10
8	Rolshavn, Trondheimsfj	$^{9}/_{4}$	42·40 ± 0·05	51·50 ± 0·17
9	Beitstadfjord	$^{23}/_{5}$	42·33 ± 0·06	51·92 ± 0·20
10	Vikna, Nordtröndelag	$^{23}/_{3}$	42·74 ± 0·08	54·27 ± 0·19
11	Rörvikbukta, Lofoten	$^{10}/_{7}$	42·72 ± 0·08	54·53 ± 0·16
12	Morfjord, Lofoten	$^{12}/_{7}$	42·77 ± 0·05	53·48 ± 0·20
13	Bjarköy, Troms	$^{16}/_{7}$	42·79 ± 0·06	53·22 ± 0·21
14	Torsvåg, Troms	$^{6}/_{8}$	42·79 ± 0·07	53·90 ± 0·15
15	Nordlenangen, Troms	$^{5}/_{8}$	42·85 ± 0·06	54·09 ± 0·20
16	Gåshopen, Söröy	$^{2}/_{8}$	42·84 ± 0·06	54·18 ± 0·22
17	Bukta, Alta	$^{31}/_{7}$	42·89 ± 0·04	54·54 ± 0·15
18	Söröyas outer side	$^{2}/_{8}$	43·00 ± 0·07	55·12 ± 0·27
19	Sandfjord, Nordkyn	$^{26}/_{7}$	42·97 ± 0·08	54·63 ± 0·30
20	Gulgofjord, Tanafj.	$^{25}/_{7}$	43·05 ± 0·08	54·81 ± 0·25
21	Mouth of river Tana	$^{23}/_{7}$	42·96 ± 0·05	54·75 ± 0·17
22	Leirpollen, Tanafj.	$^{22}/_{7}$	43·01 ± 0·06	54·49 ± 0·17

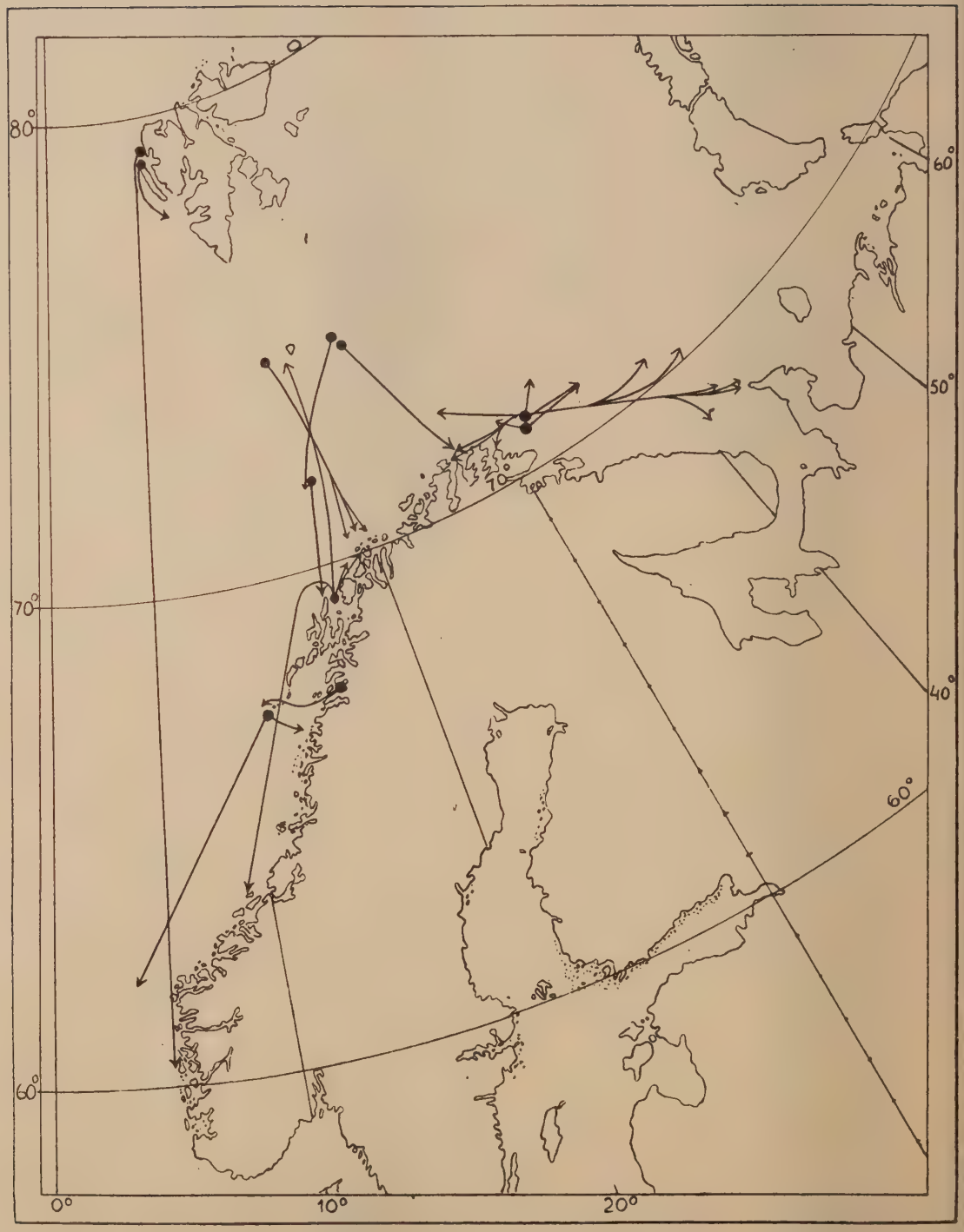

Fig. 1. Norwegian Halibut Marking. Long-Distance Migrants.

Notes on Halibut (*Hippoglossus vulgaris* Fleming).

By

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1. In a previous publication (3) the marking experiments on halibut made by Thor Iversen in the waters around Bear Island (1929—31) have been described; new recaptures from these experiments have not been recorded since then. Iversen marked a total of 315 halibuts, 22 (or 7 %) of which were recaptured within the first 12 months and 1 at a later date. — These experiments seem to indicate that an emigration from the Bear Island waters towards the Norwegian coast is by no means infrequent; — 4 of the recaptures, thus, were made in Norwegian waters. These long-distance migrants have been recorded on the map (Fig. 1).

2. Two more marking experiments were carried out by the author: in Glåmfjord (29 indv.) and Sörfolla (68 indv.); these experiments also are described in the above-cited publication. — The Glåmfjord experiment has not given any more recaptures but the 2 recorded in the description, but in connexion with the Sörfolla experiment another 2 recaptures have been reported bringing up recaptures to 21 indv. — In this case large mature individuals caught by halibut-nets were selected for marking from the Sörfolla spawning area where the depth is about 500 m. The experiment proved that 25 % of the individuals caught could not stand being caught by nets and being hauled from the 500 m. depth to the surface for marking. It is highly probable that 51 only of the 68 individuals have survived the marking, and the recapture percentage, therefore, may be considered somewhere about 40 %. — One of the new recaptures was made off Röst, and constitutes the first recapture made on a real sea-bank of halibut marked within a fjord. It was caught on March 11th, 1938, or 419 days after marking. The length at recapture was reported to be 76 cm. but 1 cm. more than that measured at the time of liberation, and it may safely be assumed that the two lengths were not measured similarly. The other recapture took place on the spot of marking on Dec. 7th, 1939, after 693 days of liberty. This specimen was a male individual which had grown from 102 to 115 cm. or 6·5 cm. per year.

3. In the above-mentioned publication marking experiments on halibut at the Röst banks (May, 1937) also have been reported; from this experiment one more recapture has been reported — bringing up the total number to 4 out of 88 marked. This recapture was made at the Aktivness off Möre at a depth of 150 fathoms (62°35′N., 3°44′E.) on April 2nd, 1938. During the 319 days' liberty it had grown from 76 to 82 cm. — or 6 cm. — According to the opinion of fishermen the place of recapture is essentially one where halibut gather during winter for spawning. The state of the gonads, unfortunately, is unknown.

4. 25 large halibut were marked between July 8th and 19th, 1937, east of the Faroe Islands, but hitherto no recapture has been reported.

5. To complete the halibut markings of Thor Iversen, at Bear Island, and in order to investigate the vitality of halibut thrown overboard after catch by an ordinary trawl, the author — thanks to the kind obligingness from the firm "Nordhav" Inc. of Kristiansund — had an opportunity to travel by the trawler "Nordhav I" to the Bear Island district during June 1938, and thus to mark all halibuts caught by the trawl. Unfortunately, the waters east and south of the Bear Island were rich on cod, thus favourable to the legitimate business of the trawler, but in these districts halibut is known to be scarce, and the final result as to halibut markings was the marking of no more than 33 individuals between June 6th and 22nd, varying in size from 52 to 118 cm. 2 recaptures so far have been reported, one 20 days later and close to the place of liberation; the second one — marked on June 18th at 74°25′N., 22°03′E. — was caught 30 days after liberation off the Norwegian coast at 71°46′N., 17°15′E. (see the map, Fig. 1). In 30 days this individual had travelled at least 184 naut. miles at an average speed of 6·1 naut. miles per day.

The material is too limited to form any opinion as to the vitality of trawl-caught halibut again thrown into the sea, but it proves, though, that single individuals can survive the treatment. — A recapture percentage equal to that of the Iversen-

experiments on line-caught halibut would hardly permit of more than two recaptures out of 33 indv. marked.

6. Between Febr. 5th and 11th, 1938, 44 net-caught mature halibut were marked in the Andfjord at 68°15′N., 16°22′E., as a parallel experiment to those of Glåmfjord and Sörfolla; the recaptures are recorded as follows:—

examination; the length-distribution was similar to that of the marked specimens, but all proved to be immature. The recaptures are recorded as follows:— (See Tab. 2.)

28 individuals recorded from the experiment show that 15 were recaptured within 12 months of liberation — or 7·5 % (sea map, Fig. 3). This recapture-percentage corresponds to that of the

Table 1.

Records of Halibut recaptured, marked in the Andfjord at 69°15′N., 16°22′E., 5th—11th February, 1938.

Total Number marked: 44.

Tag No.	Date marked	Size cm.	Locality of Recovery	Date of Recovery	Days at Liberty	Naut. Miles travelled	Nationality of Vessel
4	5/2	111	Andfjord	11/1—39	340	—	Norwegian
5	5/2	109	Andfjord	4/3—38	27	—	„
11	5/2	102	74°10′N., 17°50′E.	15/5—38	99	300	German
14	8/2	131	63°38′N., 10°55′E.	24/4—39	443	385	Norwegian
17	8/2	132	Andfjord	15/3—39	400	—	„
19	8/2	97	69°56′N., 17°10′E.	2/5—38	83	44	„
20	9/2	95	Andfjord	4/4—38	54	—	„
26	11/2	154	Andfjord	5/3—38	22	—	„
28	11/2	71	70°02′N., 18°50′E.	6/11—39	633	67	„
29	11/2	117	Andfjord	13/12—39	670	—	„
33	11/2	116	Andfjord	15/2—40	734	—	„
35	11/2	117	Andfjord	8/2—39	362	—	„

All specimens recaptured were male. For the catch of halibut cod-nets were used as well as halibut-nets; the comparatively small-meshed cod-nets caught more than the halibut-nets and preferably the minor males. Out of 44 individuals marked 6 only could with certainty be recorded as females while 4 sex determinations must be considered doubtful — the balance were all male individuals.

All recaptures within the Andfjord took place between January 13th and April 4th, thus, during the spawning season; 3 were caught here in the same year, 3 during the following season, and 2 during the season 1939—40. Recaptures outside the spawning season were all made outside the Andfjord; one by a German trawler at the Bear Island and one near Fröya off the Trondheimsfjord. The Andfjord experiment thus supports the theory that mature halibut may travel far afield for food between the spawning seasons, and that they will return to the spawning ground where they used to spawn.

7. Between March 22nd and April 7th, 1938, the author had an opportunity to mark 200 halibut on the "Northbank" in the Barents Sea, — 16 individuals at 70°53′N., 31°00′E. and 184 individuals at 71°05′N., 31°47′E. The length of these fish varied between 54 and 100 cm. — The length-distribution is recorded in Fig. 2. — Simultaneously a sample of 143 individuals were killed for closer

Iversen-experiment at the Bear Island bank. During the next year 12 — or 6·9 % of the remaining number — were recaptured (normal mortality not being considered). During the 3rd year but one recapture has been recorded. More recaptures would undoubtedly have been recorded if war-conditions had not brought trawling to a stop and decreased the line-fishery on the banks off Finmark during the spring of 1940.

Positions of liberation as well as recapture have been plotted on the map (Fig. 3); this also shows the time-distribution of recaptures. From September to February 2 recaptures only were reported while the bulk of the rest — as was to be expected — were made between March and May. During this period a large fleet of line-vessels is engaged in these waters for the "Lodde"-fishery. It is interesting to observe that no recapture took place after the month of May in the year of the experiment on the Northbank, whilst one was caught further east on the Skolpenbank (June 1st) and 3 off the White Sea estuary during July—August. — The next recapture was made in March, 1939, again on the Northbank. The experience of the fishermen states that the halibut arrives at the Northbank in March, remains there during April and May but after this month it is very scarce. From where it comes and where it goes we do not know; first-year recaptures show eastward migrations as far as the White Sea. Second-year recaptures record 3

Table 2.

Records of Halibut recaptured, marked at the Northbank, 1938.

Total Number marked: 200.

Tag No.	Date marked	Size cm.	Locality of Recovery	Date of Recovery	Days at Liberty	Naut. Miles travelled	Final Size	Nationality of Vessel
			Liberated at 70°53′N. 31°00′ E.					
57	22/3	69	71°26′N., 30°00′E.	22/5—39	426	40	76	Norwegian
61	22/3	70	71°00′N., 36°00′E.	1/6—38	71	98	—	,,
67	22/3	81	71°16′N., 33°00′E.	12/8—39	508	43	95·5	,,
			Liberated at 71°05′ N. 31°47′ E.					
88	28/3	64	70°55′N., 29°20′E.	9/6—39	444	50	—	,,
91	28/3	78	71°00′N., 30°50′E.	12/4—38	21	22	—	,,
92	28/3	60	71°42′N., 33°40′E.	16/11—39	604	50	70·8	,,
94	28/3	74	Northbank	12/3—39	349	—	80	,,
95	28/3	69	Northbank	20/3—39	357	—	71	,,
101	28/3	79	70°56′N., 32°50′E.	21/4—38	24	35	—	English
103	28/3	64	71°12′N., 31°50′E.	4/5—38	37	29	66	Norwegian
113	28/3	65	70°45′N., 31°45′E.	30/4—38	33	20	—	Russian
117	28/3	70	71°10′N., 30°55′E.	22/4—38	25	20	71	Norwegian
122	30/3	70	69°05′N., 42°15′E.	29/7—38	121	242	—	Russian
124	30/3	74	71°05′N., 26°10′E.	13/9—40	897	115	92	Norwegian
136	30/3	65	71°00′N., 31°35′E.	21/5—38	52	13	64	,,
142	30/3	62	68°47′N., 40°40′E.	26/8—38	149	220	—	English
145	30/3	72	71°11′N., 42°26′E.	1/7—39	458	210	—	Russian
157	30/3	73	70°25′N., 40°01′E.	15/4—39	381	170	81	Russian
170	5/4	77	70°55′N., 32°40′E.	22/4—38	17	16	—	English
175	5/4	67	71°26′N., 31°09′E.	12/4—38	7	27	—	Norwegian
179	5/4	70	68°48′N., 43°03′E.	26/6—39	447	270	—	German
184	5/4	93	71°13′N., 33°00′E.	12/8—39	494	23	95·5	Norwegian
205	5/4	70	71°07′N., 31°35′E.	20/4—39	380	5	78	,,
208	5/4	65	71°17′N., 31°40′E.	20/4—39	380	10	70	,,
211	5/4	79	71°36′N., 30°15′E.	24/3—39	353	44	86·5	,,
226	5/4	70	68°45′N., 43°15′E.	27/8—38	144	277	—	Russian
231	5/4	66	71°10′N., 26°45′E.	10/6—39	431	98	—	Norwegian
256	7/4	82	71°08′N., 27°50′E.	24/6—39	443	100	96	,,

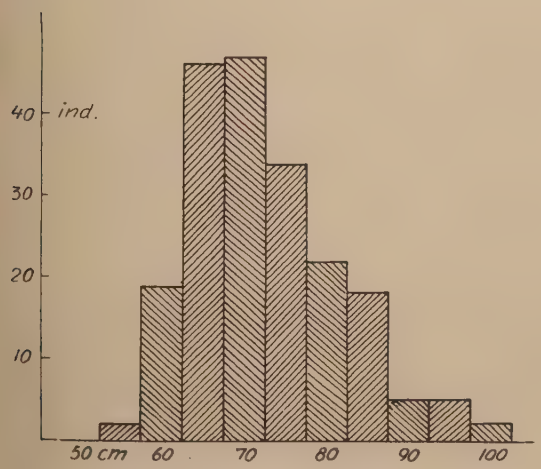

Fig. 2. Length-Distribution of Halibut tagged at the Northbank (E. Finmark) in 1938. (200 fish in 5-cm. groups.)

off the White Sea (April: 1; June: 1 and July: 1), and 3 on the Northbank in June, 2 in August, and 1 in November. Any theory, therefore, must be limited to stating that the halibut appearing on the Northbank in the spring *may* travel towards the White Sea in east and towards North Cape in west, or that they may remain on the Northbank. — The scarcity of recaptures between September and February may very well be due to the limitation of the bank-fishery at this season.

All halibut markings of 1938 were made with the American type of mark (9). Thor Iversen (1929—31) and the author (1937) both used the ordinary plaice- or cod-mark: 2 buttons connected through the gill-cover by a silver-string. It is noteworthy that with the exception of the first year, recaptures with this type of mark are scarce (an experience also known from our plaice-markings) while the American type of mark gives a number of recaptures during the second year equal to that of the first one.

8. Off the Norwegian coast — at 71°46′N.,

17°15′E. — 9 halibut were marked between July 15th and 19th, 1938, by the skipper Halvdan Kaurin. One of these was recaptured on Sept. 1st, 1938, of Andeness. During this cruise Mr. Kaurin caught one halibut marked by the author east of Bear Island.

9. Another skipper, Robert Pedersen, was instructed in marking halibut in order to mark such halibut as might be caught during the cod-fishery off Svalbard. The marking was carried out during the period August 5th to 9th, 1938, off north-west Spitsbergen, a total of 37 halibut. The recaptures are given in Table 3.

Table 3.

Records of Halibut recaptured, tagged off Spitsbergen in 1938.

Total Number marked: 37.

Tag No.	Date marked	Locality of Liberation	Locality of Recovery	Date of Recovery	Days at Liberty	Naut. Miles travelled	Initial an final Size
435	6/8	78°47′N., 9°46′E.	77°46′N., 11°30′E.	7/9—38	32	75	68—70
464	6/8	78°47′N., 9°20′E.	78°47′N., 9°20′E.	17/8—38	11	0	70— ?
474	7/8	79°04′N., 9°16′E.	78°47′N., 9°20′E.	21/7—39	348	17	68— ?
32	9/8	79°24′N., 8°45′E.	60°16′N., 4°54′E.	5/4—39	239	ca. 1200	109—12

4 individuals — or 10·8 % — were recaptured within a year of liberation. The most remarkable of these is No. 32, caught off Storesund near Bergen 239 days after liberation near the northernmost part of Spitsbergen. The distance between the two positions is about 1200 naut. miles and the travelling speed thus averages a minimum of 5·1 naut. miles per day. The fish being caught off Bergen the author had the opportunity of examining the individual. It was a recently spent male, and having lived some time on the spawning ground the speed at which it has travelled must have been considerably more than 5·1 naut. miles per day.

From the table it appears that a second individual was recaptured 75 naut. miles from the marking position, known as the Sentinellebank, after 32 days at liberty. On the other hand a third specimen was caught nearly a year after liberation, but 17 naut. miles away; this fact seems to indicate that halibut may spend the winter so far north.

Chiefly based on Danish and Norwegian investigations the main lines as to the biology of the halibut may be summed up as follows:—

Å. Vedel Tåning (8) has compiled a summary of his own — with those of other investigators' — records of halibut eggs and larvae in the northern Atlantic. These prove that the halibut spawns at deep waters (down to more than 1000 m.) west and south of the submarine ridge connecting the Faroes, Iceland and Greenland, and probably also west of Greenland. Norwegian investigations (3 and 7) show that the halibut spawns at a series of localities within the deep Norwegian fjords, from Bergen northwards to Stjernsund in the Finmark. Spawning has also been ascertained on the edge of the bank off Möre, as for instance near the Aktivness (4). Spawning takes place in warm Atlantic water — temperature 3 to 8° C.; according to Tåning (8) chiefly during the period March to May, but according to Norwegian observations between late December and April near the Norwegian coast.

The eggs are pelagic and measure from 3·0 to 3·8 mm. in diameter; they are hyaline with small perivitelline space and without oil-globule. Their appearance at the various stages of development has been described by Rollefsen (7) who has experimented on artificial fecundation of halibut eggs from fish spawning in the aquarium of the Trondheim Biological Station. — In his publication Rollefsen presents a series of excellent pictures of the embryonic development.

Trustworthy records of halibut eggs from Norwegian waters have been made — according to the literature — by Damas near the Aktivness in November 1905 at 400 m., in the Bud-deep in March 1906 at 300 m. and in the Breisund-deep at 300 m. (7), — by O. Sund in the Trondheimsfjord, the Glåmfjord and at Öksund (Nordland) in February 1938, and by the author (also in February 1938) at Outer Malangen (Troms) and in the Stjernsund (Finmark). Sund and Devold both employed the 2-m. horizontal net that was hauled for ½ to 1 hour at 600 m. wire. The catches each contained up to 6 halibut eggs which had to be picked from several litres of deep-plankton mostly consisting of *Calanus hyperboreus*, *Euchaeta* and *Metridia*. In the Stjernsund halibut eggs were taken also from the less saline and colder coastal water forming the upper 180 m. layer. In this layer no other plankton was taken, but 1—3 halibut eggs separately.

Catch of halibut larvae in Norwegian waters has been recorded by Damas only. During March 1906, a halibut larva was taken in the Herlöfjord, stage: symmetrical, and two were recorded from the Jörundfjord near Sæbö (300 m. wire) in April and June respectively of the same year (7). A symmetrical larva taken off Kristiansund by G. O. Sars by August 1871, has been determined by Collett as a halibut larva (1). A drawing of this larva, published by C. G. Joh. Petersen (Danish Biol.

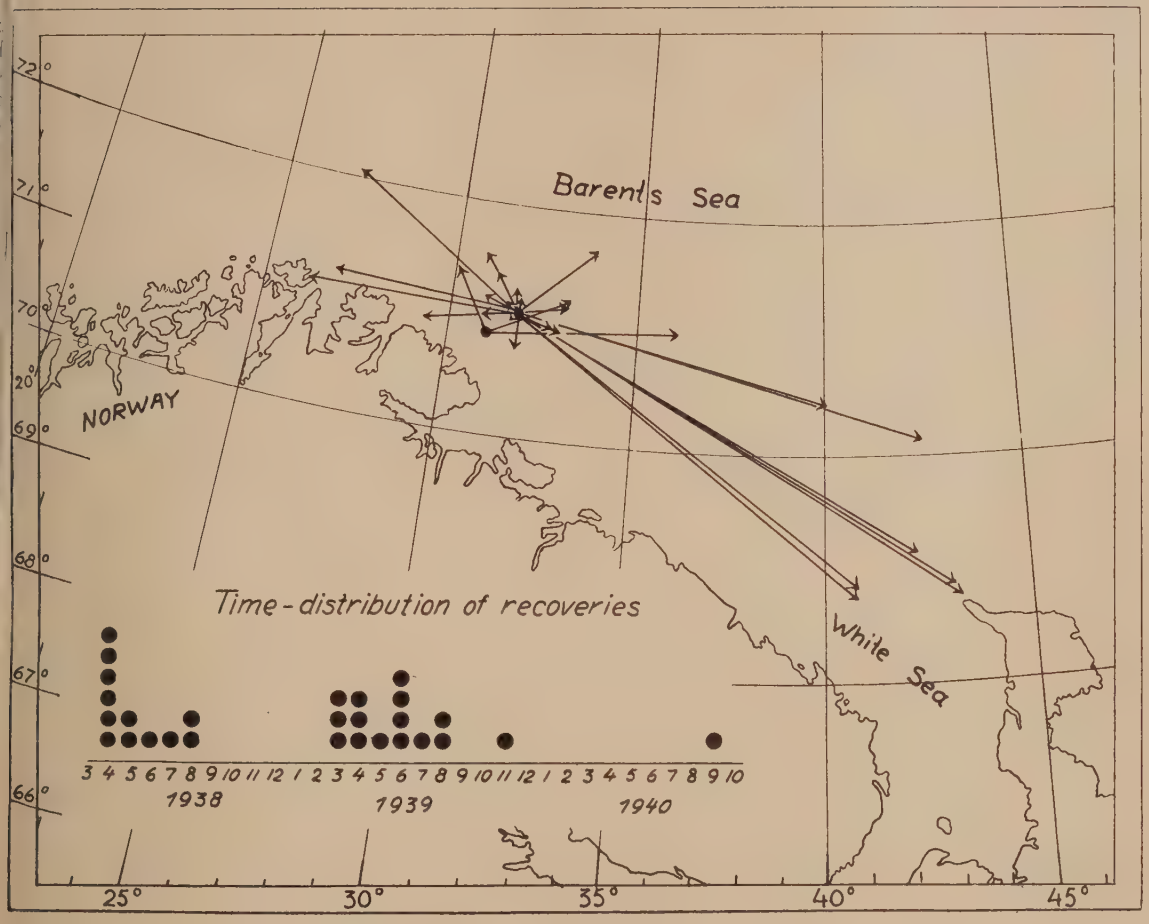

Fig. 3. Recaptures of Halibut tagged at the Northbank.

Stat., IV, 1893; Pl. 1, Fig. 20), however, fixes this larva as one of *Pleuronectes cynoglossus*.

The log-books kept by Knut Dahl in 1898 (2) contain the earliest records of halibut at the bottom-stage that with certainty can be accepted as far as Norwegian waters are concerned. A small halibut of about 8 cm. length was then caught at Skjeidhavn, Leka, on August 30th, 1898 and 2 individuals, 6—8 cm., were caught on fine sand by Danish seine hauled from the shore from the 3-fathom curve to the coast. Dahl writes: "Few in numbers they were caught although they seemed commonly appearing; now and then I could record specimens among younger plaice and other fish usually caught at the coast." In his report Dahl also publishes a drawing of an 8-cm. halibut. In recent years, however, hundreds of coastwards hauls made at numerous localities in northern Norway but twice have failed to yield individuals of less than 10 cm. length. One was caught in the Alta bay on July 31st, 1935, measuring 8 cm., another at Storsanden, Sandhornöya (Salten), on October 27th, 1939, measuring 7·6 cm. The former was caught by shore-seine, the latter by a small young-fish trawl hauled from a bank at 8—10 m. depth. Danish records from the Faroe Islands and Iceland show that the halibut at the youngest bottom-stages frequent somewhat greater depths than the plaice. Probably similar habits of the Norwegian individuals are responsible for the rare catches by our own investigators. Norwegian studies of young fish are generally restricted to shallower coastal waters and to the shrimp grounds at 100 m. depth or more. The area between the 10 and the 100-m. curves are but poorly investigated as to young fish at or near the bottom in Norwegian waters.

Having reached a size (of more than 20 cm.) catchable with the ordinarily used seines, it is regularly caught along the entire Norwegian coast although it seems more common northwards from

Möre than towards south; — it is frequently caught by line-fishermen. — On the open-sea banks individuals of less than 40 cm. are but rarely recorded; at the Barents Sea and at Spitsbergen specimens less than 50 cm. in length are very scarce. Throughout the many years of experiments made by Thor Iversen and E. Koefoed a single specimen of 47 cm. has been caught near the Bear Island — all other individuals caught measured more than 50 cm. (acc. to Koefoed). Off the Finmark coast, however, halibut of less than 50 cm. length are quite common. Summarizing our present knowledge this seems to indicate that halibut in Norwegian waters during their first two years of existence inhabit coastal waters of greater depths than those frequented by the plaice. From the Finmark coast a certain percentage pass the deep parting coastal grounds from the Barents Sea banks when reaching a length of about 50 cm. (3—5 years old according to our present knowledge). Similar habits have been described by P. Jespersen in respect of the Faroe stock (5). The Barents Sea is a feedin district in which the halibut appears as far nort as the 79°N. Latitude, W. of Spitsbergen. Th halibut area thus seems to have a norther boundary similar to that of the cod.

Judging from the study of the otoliths maturit seems to be attained at very different ages. Fro the material at disposal the author comes to th conclusion that the youngest male spawners hav been about 7 years old, the oldest one 17 years ol at first spawning. Females seem to reach their fir spawning at ages varying from 8 to 18 years.

Just before spawning the halibut seems to searc for suitable spawning districts within the dee Norwegian fjords or ocean-bank pools covered h soft clay or mud where spawning takes place i relatively warm Atlantic water. Between spawnin seasons the halibut may travel far afield in searc of food. At present our knowledge is too restricte to state with any certainty that the individual *always* will seek the same spawning ground.

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The Age and Size of Herring in 1939.

By

Oscar Sund.

THE following samples of herring from the great fisheries (mostly from seine catches) were examined as to age, type of ring, number of vertebrae and length. The samples consisted generally of 200 fish.

Winter herring	38	samples
Fat herring	6	„
Small herring and "musse"	8	„
North Sea herring	1	„
First-catch herring (mixture)	3	„

Winter Herring.

The *age composition* of the several samples is given in Fig. 1. Even if we find, practically, the same year-classes to predominate within the large-herring samples — i.e., those of 1930, 1932, and 1933 — a distinct change is notable in the composition of the "community" if we reckon from the first to the last sample (from December 21st to January 11th), inasmuch as the two younger year-classes are stronger in the beginning, the older one at the end.

In those samples which may be called spring herring, because they are approaching the spawning stage, the 1930 year-class is at the outset less dominant than the other two, whereas in February it constitutes the chief element, together with the 1932 year-class, while in the last sample (March 2nd) both fall heavily below 1933 and a still younger year-class, 1934, comes forth with a large percentage.

The examination of the age composition of these samples gives rise to two considerations. First: the variation in age from one sample to the other shows that the herring stock which comes to the coast in winter does not originate from any homogeneous mass in the sea, and there can neither be the question of any grouping according to age or size. It is therefore natural to conclude that the herring masses which occur in winter in such dense formations off the Norwegian west coast must be spread over very wide areas during the rest of the year — maybe over the greatest part of the Norwegian Sea. If the legions of winter herring lived in a minor area during the other seasons than the Norwegian one, it would be quite impossible to

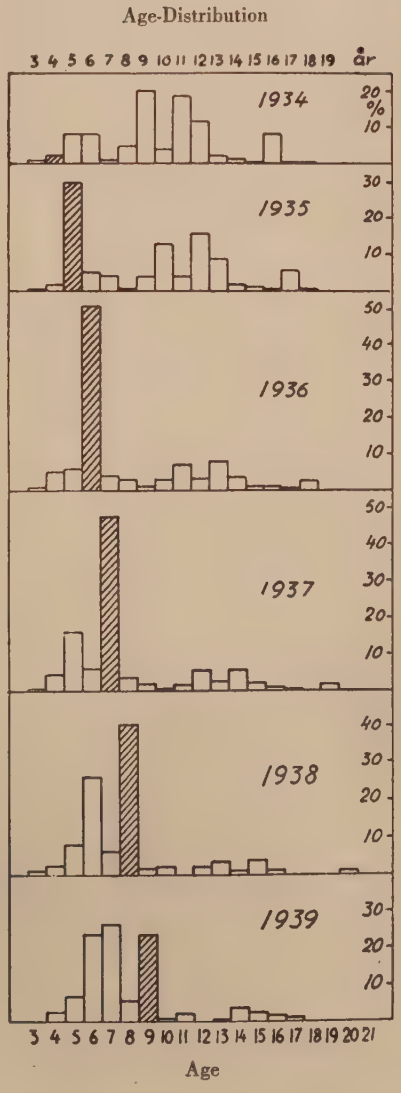


Fig. 2. Average Age-Distribution of Winter Herring during 1939 and the preceding five Seasons.

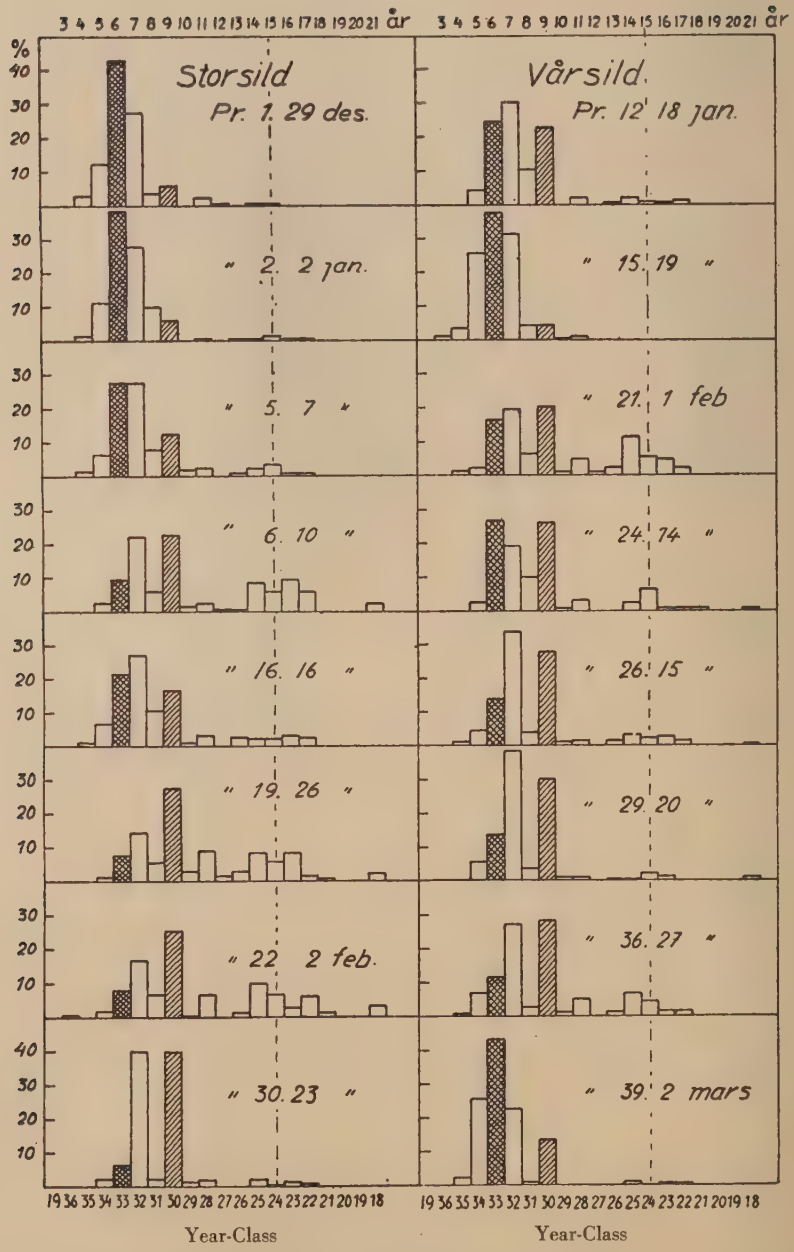


Fig. 1. Percentage Age-Distribution of Samples from Winter Herring during the Season 1938—39.

Table 1. Samples of Fat Herring 1939.

Locality	Date	Age (Years)							Length (cm.)								Av. Length	No. of Fish
		4	5	6	7	8	r	?	22	23	24	25	26	27	28	29	30	
Godfjorden (Hinnøya)	13/4	3	88	102	2	—	3	5	—	—	6	76	82	25	4	4	3	25·85	200
Rausand (Senja)	14/4	3	144	37	2	1	5	8	—	3	33	104	49	11	—	—	—	25·16	200
Gangsåsen nr. Harstad	25/4	—	71	24	1	—	3	1	—	—	4	43	46	5	—	1	1	25·61	100
Eidsfjorden (Langøya)	25/4	1	71	22	3	—	2	1	—	—	—	34	47	16	3	—	—	25·88	100
12° n.m. E. of Vardø	9/8	—	15	53	3	—	3	1	2	2	26	34	26	10	—	—	—	25·10	100
East of Vardø	18/8	7	36	18	—	—	1	—	3	16	24	22	10	3	—	—	—	24·37	78

Table 2. Samples of "Musse" and Small Herring 1939.

Locality	Date	Length (cm.)																Av. Length	No. of Fish
		6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21		
Tysfjord	29/4	—	—	108	225	202	142	52	11	—	—	—	—	—	—	—	—	9·79	738
Tysfjord	8/5	—	—	113	274	170	89	41	14	—	—	—	—	1	—	—	—	9·60	702
Sifjord (Senja)	2/11	193	302	269	218	121	34	—	—	—	—	—	—	—	—	—	—	7·89	1137
Dypingen (Bjarkøy)	8/11	20	83	149	224	222	95	21	2	—	—	2	—	—	—	—	—	9·15	818
Sifjord (Senja)	15/11	43	157	182	226	230	93	12	—	1	—	—	—	—	—	—	—	8·84	944
Rausand (Senja)	21/11	29	106	187	249	271	80	9	—	—	—	—	—	—	—	—	—	8·97	931
Herjangen (Ofoten)	20/10	—	—	—	—	—	—	1	—	17	23	21	21	11	4	1	1	16·03	100
Skjomen (Ofoten)	20/10	—	—	—	—	—	—	—	2	22	20	28	20	5	2	1	—	15·70	100

explain why there is no greater uniformity among the samples.

Second: it is satisfactory to note that there are now at least three — possibly four — comparatively rich year-classes in the sea; this should warrant an abundant supply of herring in the first years to come. If we compare the average age composition of all winter-herring samples from the whole year (as shown in Fig. 2) with that of the preceding 5 years it is evident that the stock is now based on a broader foundation than in those 5 years. In 1934 there were certainly also several good year-classes, but they were older — 9—12 years as against 5 or 6—9 years now — and consequently a greater toll had already been taken from them. If I remember rightly, bad weather conditions accounted in 1934 for the small returns of the winter-herring fishery (1·1 mill. hl., or the minimum on record since 1909), but a small stock has undoubtedly been a concurrent cause in the failure of the fishery.

The *length* of the winter herring which is given in Fig. 3 shows a very uniform distribution; the greatest number of fish fell at 32 and 33 cm., the lengths being thus somewhat larger and more uniform than in the preceding year.

Length-Distribution

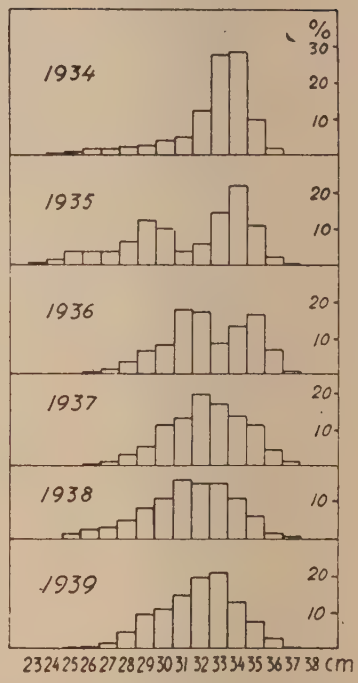


Fig. 3. Average Length-Distribution of Winter Herring during 1939 and the preceding five Years.

Fat Herring.

As is well known, very few fat herring have been caught off the Norwegian coast since the beginning of this century — with the exception of some few years, as for instance 1928 and 1933. This is clearly illustrated by Fig. 1 in my paper on "Fat and Small Herring .....", see p. (59).

There has been great divergence of opinion as to the reasons why the fat herring seemed to stay away. Unless this phenomenon is taken apart, but considered in close relation with the great northwards displacement of the skrei fishery and with the great increase in the temperature of the waters off the Norwegian coast, it is only natural to believe that a similar northwards displacement has occurred in the fat-herring fishery. This hypothesis was actually proved true by the successful fishery experiments in the autumn of 1939 in the waters east of Vardø which gave fat herring of the same kind as those fished in 1939 off the southern coasts (though not in very great numbers), see Tab. 1. As in olden times the herring were 5 and 6 years old and had a length of 25—26 cm. The herring from the eastern waters were slightly smaller than those from the south — as could be expected since the growth-period is shortened the farther we go to the north.

"Musse" and Small Herring.

Unfortunately, the statistics do not discrimin between these two length categories, which dif so much both in length and fat-content, a consequently in use. This difference is partly sho by Tab. 2 which gives the measurements of a ser of samples from both categories. In autumn, small herring have a length of 14 to 19 cm., "Musse" 6 to 13 cm. only; in spring, the latter somewhat larger, they cannot, however, be used anything but fishmeal, the fat percent being small. In the last 30 to 40 years the small-herri and "Musse" fishery had to replace the fat-herri fishery of former times (see the above-mentio figure). There is no reason why the old herri times should not return, but it may last long.

First-Catch or Mixed Herring.

After the conclusion of the winter herri fishery at some few places off the west country mixed quality (herring from mixed stocks) is cau and sold under the curious name "first-cat herring.

The Age-Composition of the Norwegian Spawn Herring observed during 36 Years.

By

Oscar Sund.

THE collecting of samples of the spawning herring occurring during early spring along the west coast and reading their age has formed a regular and important part of the Norwegian fishery research work ever since the age-determination of fishes was introduced into the investigation of the sea fisheries. The fundamental work was made by Mr. (now Professor) Knut Dahl and Mr. Einar Lea together with the leader of the investigations at that time (1907 and onwards), Director (now Professor) Dr. Johan Hjort. The collection of samples during the first few years was, of necessity, of a more or less tentative character, greater stress being laid on the size of the individual samples than on their number and an adequate "covering" of the fishing area. Mr. Lea's assiduous researches resulted, however, in a standardisation of the size of the samples to about 200 individuals and a greater number of samples so that, from 1914, generally 30—40 samples were collected annually.

In the tabular review given here only those samples have been included which consist of herring in the actual spawning condition or about to spawn within a short time, the so-called "spring herring", the other samples, containing fish in a less advanced condition being so far left out.

The reading of the scales was performed by Mr. Dahl during the first years (1907—8), by Mr. Lea from 1909 to 1921 and since that time by Mr. Thorolf Rasmussen so that, at least, a great uniformity, if not infallibility, is achieved as far as humanly possible.

The review of the yearly age-distributions within this tribe of herrings is given here as Tab. I where all figures are recorded as parts per thousand. The last column gives the number of individuals considered for each year.

From this table average distributions may be obtained by summing up the annual compositions for certain series of years of capture, or else by considering a number of completed year-classes. The results of both methods are rendered in Tab. II and Fig. 1, viz., first the period of observation divided into sub-periods in two different ways, and, secondly, all available completed year-classes (all broods 1904—1923) in the last column, and, lastly, all years of capture in the last column but one.

As it will be seen from Tab. II and Fig. 1 the most numerous year-class is in the latter part of the observational period not the 6th but the 7th.

In his paper "Mortality in the Tribe of Norwegian Herring" (Rapp. & Proc.-Verb., Vol. No. 65, 1930) Einar Lea has worked out a method of arriving at the average mortality by using the part of Tab. I available at that time, i.e., the age-determinations up to (and incl.) the season 1927—28. His result was a "coefficient of remanence" of *0·81*, corresponding to an average yearly mortality of 19 %, and by various considerations he came to the conclusion that this numerical result should be considered a true expression of the actual

N

Yearly Age-Distribution (per m

Year	Age yrs.	3	4	5	6	7	8	9	10	11	12
1907		16	222	185	148	126	194	34	23	17	22
1908		3	348	122	116	111	85	144	19	11	15
1909		—	4	437	120	41	48	67	176	34	26
1910		—	12	100	781	68	10	4	8	16	—
1911		1	6	40	144	701	49	23	19	7	8
1912		—	15	31	38	139	646	67	16	12	13
1913		1	7	22	35	49	157	640	53	12	15
1914		1	48	35	44	44	71	143	533	45	17
1915		3	19	165	43	50	31	44	101	496	33
1916		13	101	84	189	40	40	34	31	73	364
1917		1	156	143	33	106	31	35	28	38	74
1918		—	7	201	123	39	88	31	28	26	44
1919		12	57	45	250	145	21	52	15	25	21
1920		7	72	59	49	269	90	30	56	8	21
1921		14	8	208	24	14	228	99	31	39	30
1922		2	147	257	157	10	26	138	45	13	18
1923		5	43	472	155	103	7	20	82	19	12
1924		3	24	92	478	188	93	21	19	39	15
1925		—	62	77	101	399	145	84	19	14	53
1926		1	17	173	52	76	319	142	85	19	23
1927		—	160	107	70	43	68	279	100	64	16
1928		8	36	249	123	68	68	122	184	55	35
1929		5	122	112	222	125	42	65	102	117	41
1930		4	18	87	66	231	138	54	79	71	166
1931		—	1	20	184	99	215	119	46	52	45
1932		18	31	5	37	196	74	239	142	40	43
1933		1	10	35	7	52	227	112	242	123	40
1934		13	27	86	85	11	48	201	91	188	118
1935		11	50	385	42	38	5	38	119	54	121
1936		6	44	51	501	40	27	3	31	74	41
1937		—	44	161	61	478	33	19	5	14	55
1938		7	47	140	244	46	323	14	23	3	19
1939		2	28	65	239	262	53	235	7	19	2
1940		—	3	14	259	192	226	31	181	3	21
1941		1	1	7	52	332	159	184	51	137	4
1942		1	19	113	30	113	335	132	101	39	86

g Herring.

Period of Observation (1907—1942).

16	17	18	19	20	21	22	23	24	Total	No. of Ind.	Rel. Stock Strength	Year
—	—	—	—	—	—	—	—	—	1001	924	1·00	1907
1	1	—	—	—	—	—	—	—	1001	1430	1·16	1908
2	4	2	—	—	—	—	—	—	1004	568	0·97	1909
—	—	—	—	—	—	—	—	—	999	489	9·04	1910
—	—	—	—	—	—	—	—	—	999	1544	7·28	1911
—	1	—	—	—	—	—	—	—	1001	1242	6·14	1912
—	—	—	—	—	—	—	—	—	1000	891	5·15	1913
—	—	—	—	—	—	—	—	—	999	2727	4·74	1914
—	—	—	—	—	—	—	—	—	1001	4311	4·65	1915
2	1	—	—	—	—	—	—	—	1000	6139	5·08	1916
2	—	1	—	—	—	—	—	—	1002	4291	4·50	1917
1	—	2	2	—	—	—	—	—	1001	1650	3·90	1918
13	1	1	1	1	1	—	—	—	1002	4604	4·30	1919
210	10	7	—	—	—	—	—	—	1001	5739	4·15	1920
48	152	3	2	2	—	—	—	—	1000	5513	3·70	1921
18	17	96	5	1	—	—	—	—	1000	2398	5·45	1922
8	10	4	39	1	—	—	—	—	1001	2041	7·83	1923
3	4	1	1	4	1	—	—	—	1000	2017	8·33	1924
5	4	4	5	1	6	—	—	—	1001	4022	7·65	1925
7	6	3	4	2	1	6	—	—	999	6071	6·95	1926
7	4	4	2	1	—	—	15	—	1001	3283	6·90	1927
5	2	1	1	—	—	—	—	—	998	2736	6·98	1928
4	3	1	—	—	—	—	—	—	1000	2040	7·92	1929
5	3	1	—	—	—	—	—	—	1000	1766	5·79	1930
9	1	4	—	—	—	—	—	—	997	2702	5·61	1931
8	1	1	1	—	—	—	—	—	998	3367	5·06	1932
4	1	—	—	—	—	—	—	—	1000	2367	4·15	1933
84	1	1	—	—	—	—	—	—	1000	2159	4·10	1934
2	39	—	—	—	—	—	—	—	1000	3083	5·15	1935
13	1	34	—	—	—	—	—	—	1002	2116	6·08	1936
9	3	—	18	—	—	—	—	—	1002	2448	7·50	1937
10	1	1	—	16	—	—	—	—	999	3436	8·75	1938
15	9	1	—	—	3	—	—	—	1004	1993	9·56	1939
17	9	3	—	—	—	1	—	—	1001	2554	9·68	1940
26	10	4	1	1	1	—	—	—	998	2107	9·35	1941
1	15	1	1	1	—	—	—	—	1001	1883	9·46	1942

Table II.

Norwegian Spawn Herring 1907—1942.

Average Age-Distribution (per mille) for Several Periods and for the Available Complete Year-Classes.

Age years	Years of Capture 1936 -42	1907 -35	1925 -42	1907 -24	1907 -42	year-cl. 1904 -23
3	2	5	4	5	4	4
4	27	63	40	72	56	56
5	79	139	102	150	127	127
6	198	135	132	163	147	132
7	209	124	156	124	140	120
8	165	113	139	106	123	107
9	88	106	115	90	103	101
10	57	86	89	71	80	83
11	41	60	60	52	56	64
12	33	50	52	42	47	55
13	27	39	37	35	36	47
14	24	28	24	30	27	35
15	19	21	18	23	20	27
16	13	16	13	17	15	20
17	7	9	6	11	9	11
18	6	5	4	6	5	7
19	3	2	2	3	2	3
20	3	—	1	1	1	1
21	1	—	1	—	—	—
22	—	—	—	—	—	—
23	—	1	1	—	—	1
24	—	—	—	—	—	—
	1002	1002	998	1001	998	1001

facts. Only a mortality coefficient of about t amount when applied to a computation of t relative size of the stock resulted in variations the stock in such a manner that these variatio were kept within the same order of magnitude, a only a mortality such as this, when applied to calculation of the relative strength of the seve year-classes, made these strengths lie within reas able bounds.

The coefficient of remanence has now be calculated by the same method for the entire peri of observation, viz., the years 1907—1942. T result is identical with L e a's, *0·8125*. We ha also tried the same method on a restricted part the material, the years 1925—1942 only and inste of (as L e a) using the age-groups 7—17, we ha restricted the calculation to embrace only the figu pertaining to the ages 8—15 years. Still the res is practically the same, namely *0·807*.

We have accordingly considered it permissi to calculate the size of the stock for the ent period by using the same mortality factor as L e The results are given in the last column of Tab and a representation of the variations is attemp in Fig. 2 (upper curve).

In order to show the correspondence betwe the stock size and the relative output of the fish we have calculated the yearly average output p man engaged in the use of gill-nets in the spawni area, represented in the figure by small circles. it will be seen the correspondence is, at the be very slight. This is easily understood when it remembered how many influences the output

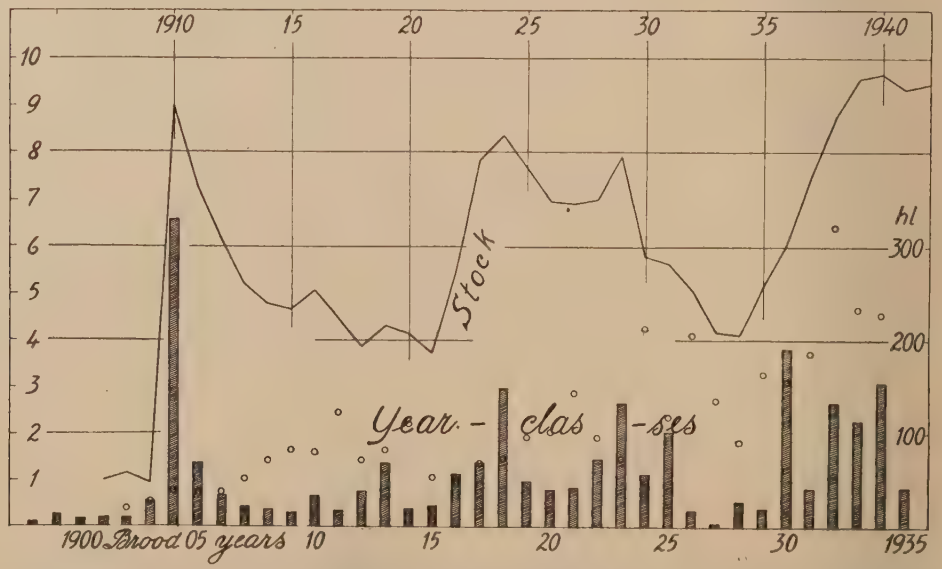


Fig. 2. Calculated relative size of the stock of Norwegian Spawn Herring with stock in 1907 as unity (upper time scale), — and relative strength of year-classes (broods) as shaded columns (lower time scale), — and yearly average output per man of herring in gill-nets, in hectolitres (upper time scale).

is fishery is exposed to: above all the weather d in scarcely less degree the depth where the rrings congregate for their spawning, this depth ing subject to the thickness of the cold coastal ater shunned by the spawning fish. Still some ight degree of correspondence may be guessed om these figures.

Lea calculated the strength of the several oods by using the mortality factor. A very milar, if not in all details identical, result was otained by a more empirical method: first expressing all entries in Tab. I as percentages of the verage age-distribution for the entire period 1907—1942) and then multiplying these percentges by the stock strengths (last col. in Tab. I) and mming up by year-classes.

The results of this calculation are rendered as haded columns in Fig. 2. Their time scale is shifted years to the right in order to obtain the best ossible correspondence with the stock-size curve. t is easily seen that the two sets of figures, the tock size and the strength of the principal yearlasses making up the stock at each epoch, agree ery well.

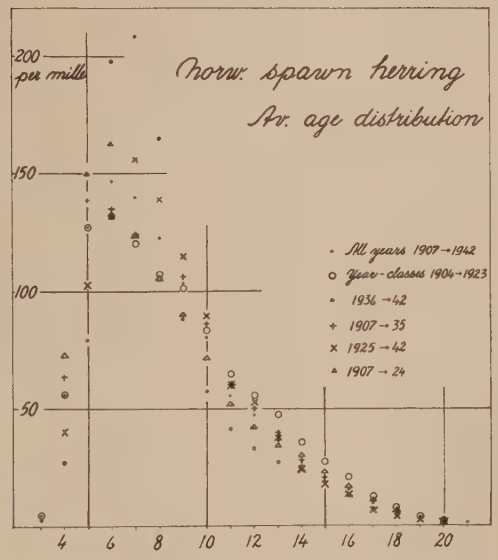


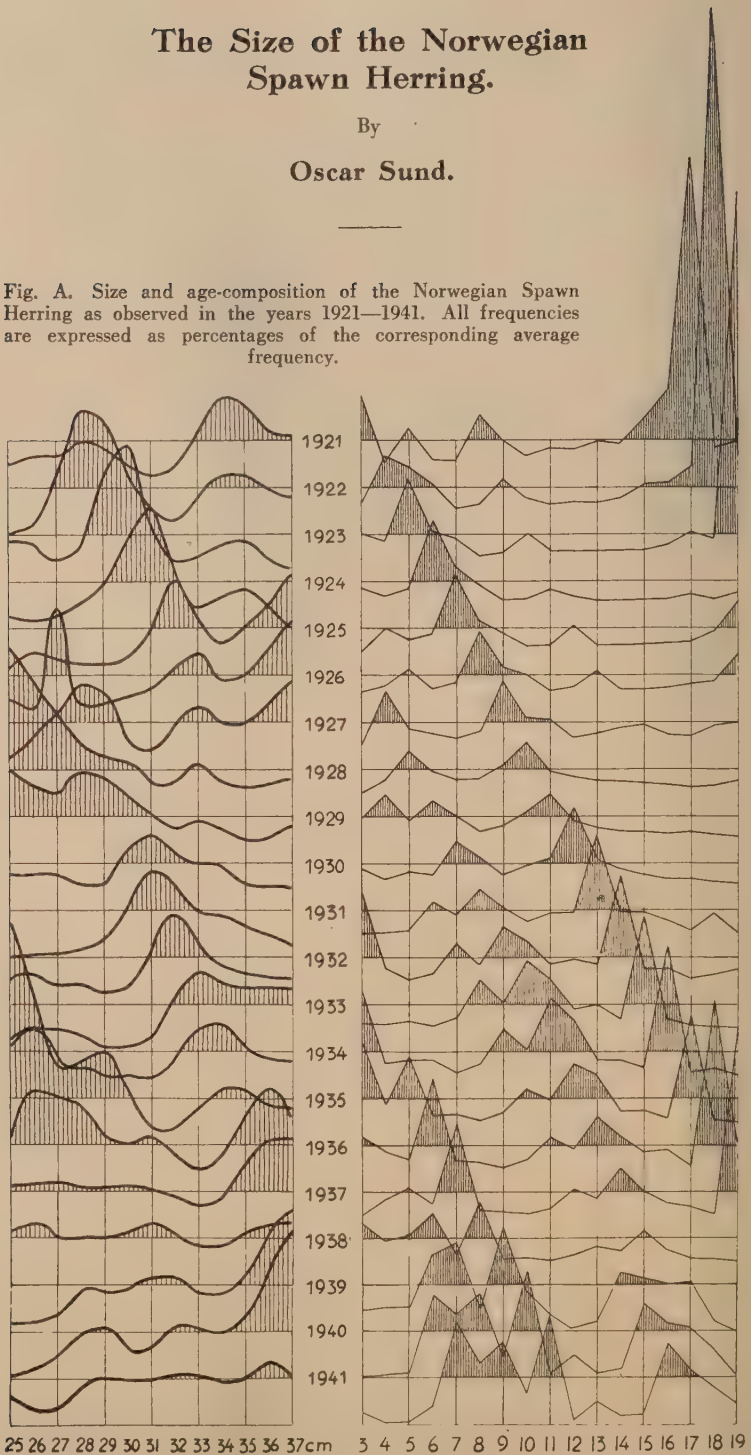
Fig. 1. Average age-compositions of Norwegian Spawn Herring during the period 1907—42 and parts of this period. The larger circles refer to the average for all year-classes completed up to the present time..

The Size of the Norwegian Spawn Herring.

By

Oscar Sund.

Fig. A. Size and age-composition of the Norwegian Spawn Herring as observed in the years 1921—1941. All frequencies are expressed as percentages of the corresponding average frequency.



OWING to the comparative facility of determining the **age** of the herring which no doubt supplies the data of the greatest importance from a biological point of view, the **size** variations of the herring have not captivated the interest of fishery investigators to the same degree as is the case with regard to other fishes, e. g., the adult cod. In the latter case the age-determination is less easy and, on the other hand, the variations in size are more conspicuous and of greater commercial importance than in the case of the spawn herring which are of a much more uniform size.

Still, the variations, if small, are large enough to give an idea of the varying age-composition from year to year and thus to give a general corroboration to the validity of the age-determinations. This is brought out by the juxtapposition in Fig. A, showing on one side the variations in the period 1921—41 from the average size-composition, on the other side the corresponding variations from the average age-distribution.

The size of the separate age-groups is found to vary but very slightly in the case of the older fish, of 8 years and more, while the younger groups exhibit much stronger variation, as shown in Fig. B. While the lower groups, namely those still receiving "immigrants" from the immature stock, vary more or less in concord, the size variations of the older groups show much less simultaneity.

It is strongly suspected that the great size variations met with in the age-groups which are mostly made up of first-time spawners, may be connected with some milieu-factor of wide and general influence.

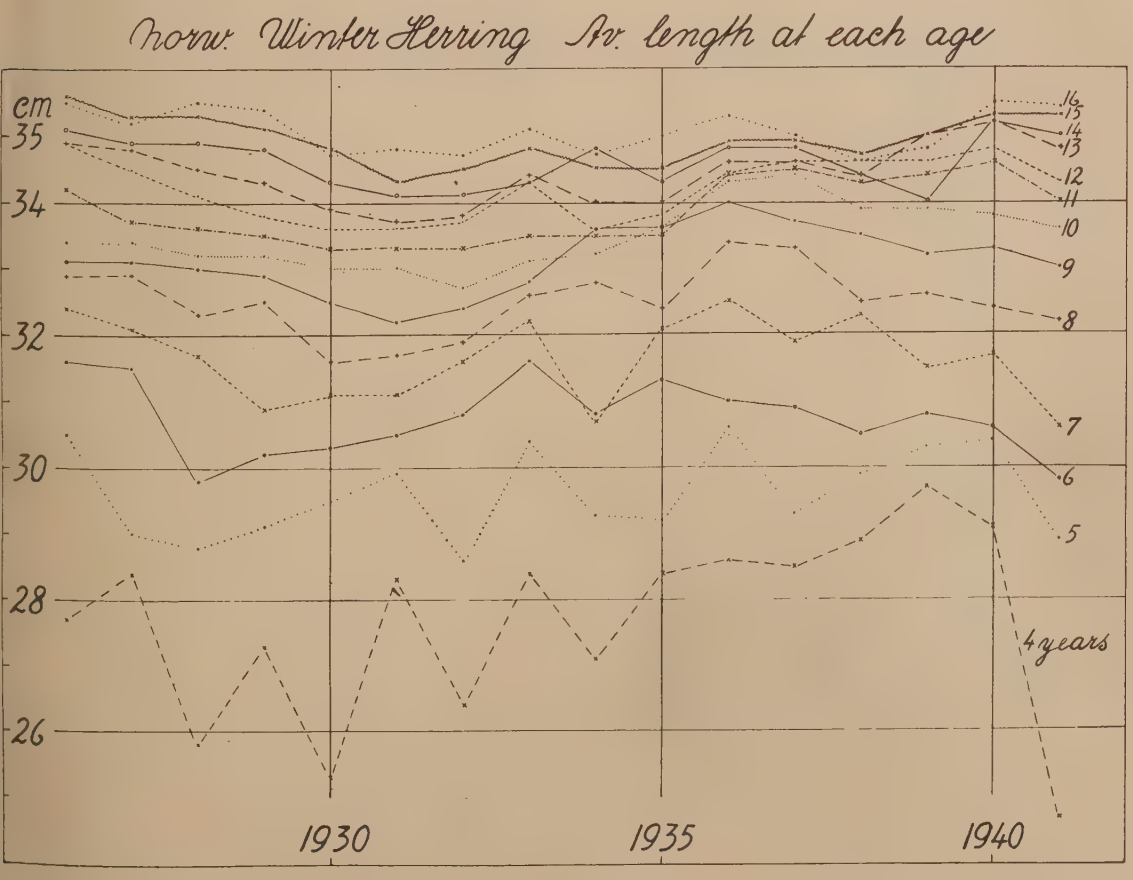


Fig. B. Size variation of each year-group of Norwegian Spawn Herring 1921—41.

Delay of Spawning in the Norwegian Herring Stock in Recent Years.

By

Oscar Sund.

WHILE analysing the 1941 observations on the Norwegian winter herring[1]) a considerable deviation from Runnström's[2]) observations in 1932 was observed with regard to the age at first spawning as revealed by the number of narrow growth zones near the edge of the scale. The rapid growth of the Norwegian oceanic herring stops as soon as maturity is reached, after which the growth zones are very narrow.

While the average age at 1st spawning in 1932 was just over 5 years, it was nearly 6½ years in 1941 (or accurately 5·15 and 6·40 resp.). The difference — 1·25 years — proves to be over 50 times greater than its probable error, being thus established as numerically real by a very wide margin indeed.

There is, however, a characteristic difference in this respect between individuals with northern and southern types of coastal winter rings[3]), and if the composition of the stock had materially changed in the meantime, this circumstance might perhaps be thought to have caused the delay in becoming sexually mature.

An analysis of the material with regard to the type of the early winter rings brought this out: while the stock in 1932 contained nearly 50 % ind. of the southern youth-growth-type, the corresponding figure in 1941 was 16·5 % only.

This divergence, however, was found to be of only subordinate importance because the rise in spawning age in 1941 relative to 1932 proved to apply almost equally to the herring of north and of southern origin, 0·98 years in the first ca 0·73 years in the second instance. And it v further found that all age-groups were affected about the same degree, the difference in relat preponderance of the various year-classes theref being of small account in this respect.

Having thus established the great change spawning age which had taken place between 19 and 1941 we considered it worth while to exte the investigation to embrace the longest possi chain of years. As the work of carrying throu

Table 1.

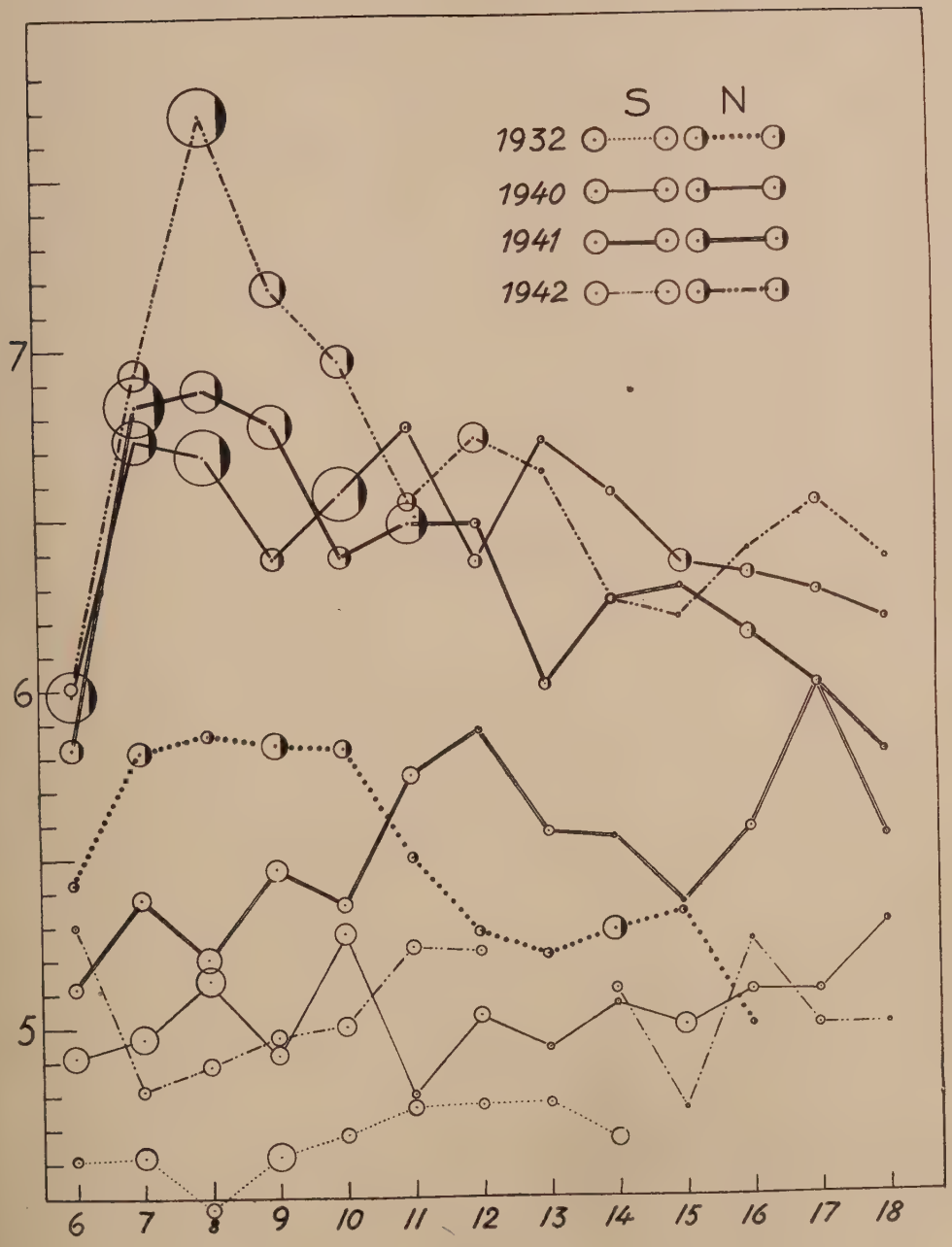
Percentage of Norwegian Winter Herrin with coastal winter rings of southern typ

Year-classes	1932	1940	1941	19
3	—	—	67	-
4	94	100	5	7
5	67	82	57	1
6	55	21	22	2
7	44	27	9	1
8	57	21	22	
9	56	42	20	2
10	38	13	31	2
11	68	38	13	3
12	52	55	36	1
13	45	50	41	2
14	35	40	24	4
15	31	46	56	4
16	38	36	37	4
17	—	29	33	3
18	—	41	41	3
All	48·7	25·8	18·4	1
7—10 only	49·7	21·9	16·5	1

[1]) Sund: Sildeundersøkelser i 1941. Fiskeridir. Skr. Vol. 7, No. 6, p. 18 & 30.

[2]) A Study on the Life History etc. Ibidem, Vol. 5, No. 2, 1936.

[3]) Lea: The Herring Scale as Certificate of Origin. Rapp. et Proc.-Verb., Vol. No. 54, 1929.



S = individuals with youth winter rings of southern type.
N = individuals with youth winter rings of northern type.
Area of circles proportionate to number of specimens.

Table 2. Norwegian Winter Herring.

Mean Age (A) at 1st spawning, Northern (N) and Southern (S) youth-growth scale type.

Years of observ.	1932				1940				1941				1942			
	S		N		S		N		S		N		S		N	
Year-classes	A	n	A	n	A	n	A	n	A	n	A	n	A	n	A	n
3	—	—	—	—	—	—	—	—	**3·00**	6	3·00	3	**3·00**	2	—	—
4	**3·94**	17	4·00	1	**4·00**	9	—	—	**4·00**	4	4·00	69	**4·00**	27	4·00	8
5	**4·00**	4	5·00	2	**4·85**	72	5·00	16	**4·58**	26	5·00	20	**5·00**	36	5·00	212
6	**4·61**	41	5·42	33	**4·91**	237	5·98	906	**5·12**	60	5·82	214	**5·30**	20	6·00	61
7	**4·62**	162	5·81	203	**4·97**	266	6·73	713	**5·38**	128	6·84	1292	**4·81**	53	6·93	296
8	**4·46**	72	5·86	55	**5·14**	287	6·69	1062	**5·20**	171	6·88	610	**4·89**	119	7·69	1185
9	**4·62**	284	5·83	226	**4·92**	119	6·38	162	**5·46**	163	6·77	650	**4·97**	109	7·18	425
10	**4·68**	68	5·82	110	**5·28**	156	6·57	1018	**5·36**	72	6·35	159	**5·00**	107	6·96	383
11	**4·76**	80	5·50	37	**4·80**	20	6·76	33	**5·74**	88	6·49	580	**5·23**	60	6·54	130
12	**4·77**	52	5·28	47	**5·03**	78	6·36	64	**5·87**	16	6·48	29	**5·22**	47	6·73	287
13	**4·77**	27	5·22	33	**4·94**	16	6·72	16	**5·57**	35	6·00	51	**5·67**	3	6·63	11
14	**4·66**	115	5·24	210	**5·07**	14	6·57	21	**5·17**	6	6·25	19	**5·11**	38	6·25	47
15	**5·33**	9	5·80	20	**5·00**	140	6·36	162	**5·56**	99	6·29	7	**4·75**	4	6·20	5
16	**5·00**	8	5·30	13	**5·10**	43	6·33	77	**5·58**	50	6·15	87	**5·25**	4	6·40	5
17	**4·67**	3	6·00	1	**5·10**	19	6·28	47	**6·00**	13	6·00	27	**5·00**	31	6·54	50
18	—	—	5·00	1	**5·30**	13	6·19	16	**5·55**	11	5·60	16	**5·00**	5	6·37	11
19	**4·00**	1	6·00	1	**5·50**	2	—	—	**6·00**	1	7·00	4	**5·17**	6	6·60	5
20	—	—	—	—	**5·00**	1	6·00	1	**6·00**	1	6·00	1	**5·00**	2	5·75	4
21	—	—	—	—	—	—	—	—	—	—	7·00	1	**5·00**	1	7·00	1
22	—	—	—	—	**5·00**	5	6·67	3	—	—	—	—	—	—	—	—
23	—	—	—	—	—	—	—	—	**5·33**	3	—	—	—	—	—	—
Tot.	—	942	—	996	—	1497	—	4317	—	863	—	3839	—	674	—	3126
Av., all	**4·63**	942	5·62	996	**5·02**	1497	6·46	4317	**5·36**	863	6·60	3839	**4·97**	674	7·04	3126
Av., 7—10 y.	**4·61**	586	5·82	594	**5·08**	828	6·64	2955	**5·34**	534	6·80	2711	**4·93**	388	7·38	2289

ch an analysis, especially the re-examination of e scale samples, is rather considerable, so far ly the material from 1940 and 1942 has been eated (in addition to that from 1932 and 41).

As a first result may be mentioned that the partition of the material on the two types of rly winter rings has been progressively in the irection of increasing preponderance of the orthern type, — as shown by Tab. 1.

The outcome of the investigation is given in umerical form in Tab. 2 and also in a graphical epresentation. The age at the 1st spawning is nown separately for each age-group and at the ottom of the table for all age-groups and for the ost important groups (7—10 years incl.).

While the delay in the attainment of maturity s far as the most numerous age-groups goes, has been progressive among the herring of northern outh-ring-type in the available observation years, he southern type shows a lesser delay in 1942 han in 1941.

Possible Causes.

The only surmise to be offered as to the cause of the great delay in maturing observed in the last 3 years is that either low temperature or a scarcity of food may be responsible.

The development of the gonads may be influenced by the conditions prevailing in the year immediately before spawning or it may be the accumulated effect of two or more seasons. The most probable cause, though, is that it is the last feeding season before spawning which is of the greatest importance in bringing about the development of milt and roe. In any case it is of interest to note that the growth seems to have been influenced in the same way as the maturing of the fish. This applies especially to each year's leading age-group (given in italics in the table below):

Age, years in	Length in mm 5	6	7	8
1932	*287*	308	315	317
1940	—	*305*	317	324
1941	289	298	*306*	322
1942	279	297	308	*316*

At our request Dr. Eggvin (of our Bureau's Oceanographic Department) has kindly searched for temperature data which might afford a clue to the understanding of the phenomenon under discussion but without success. A more positive result was, however, scarcely to be expected as our investigations during the years in question have (outside the North Sea) generally been limited to the coast and the banks while the herring is known to roam over very wide areas in the summer time.

One might perhaps conjecture that the stronger north-drift of the upper water layers in recent years has moved the herring shoals somewhat farther than usual into cold regions, thus exposing them to less favourable conditions for growth and development. If this were true one would expect the return of the herring to the spawning areas to be delayed on account of the greater distance to be covered during the spawning migration. This was also the case:

Date of commencement of fishing:

Season	Date
1932	18th Dec. 1931
1940	1st Jan. 1940
1941	24th Dec. 1940
1942	8th Jan. 1942
1943	20th Jan. 1943

Variation of the Number of Vertebrae in the Norwegian Winter Herring.

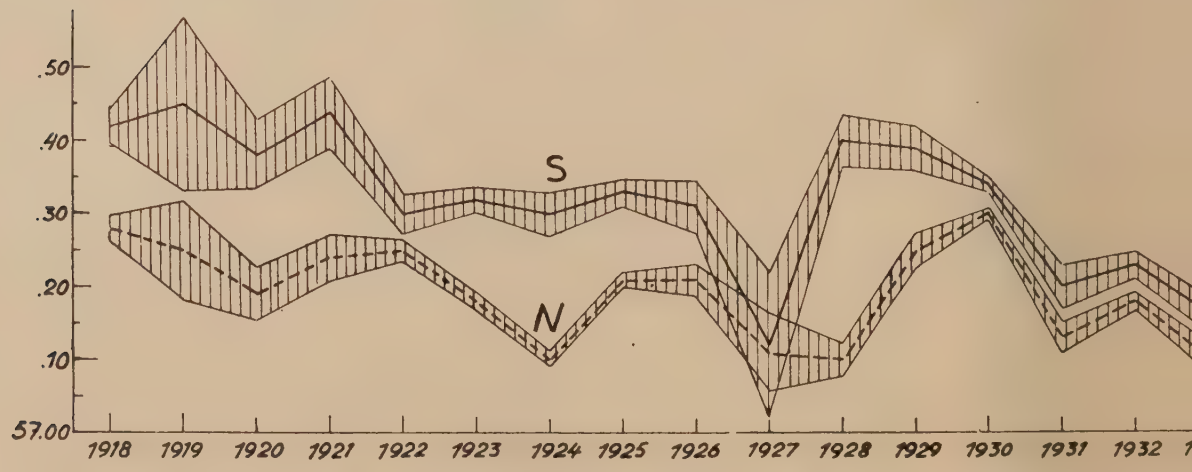
By

Oscar Sund.

THE number of vertebrae have been counted in samples of Norwegian winter herring from the season 1932—33 until the last, covering the 17 year-classes: 1918—1934. The results of this investigation show a distinct difference between samples obtained from the west-coast districts south of Bergen and those from the coast north of Bergen. The former set of samples corresponds to herring in the stage of sexual development known as spring-herring while the samples collected north of Bergen are mainly derived from the shoals of large herring which display an earlier, though advanced, state of maturity.

The results have been tabulated so as to ena the average number of vertebrae to be calcul for each year-class separately. Unfortunately number of specimens belonging to two of the year-classes is very small owing to the compara scarcity of herring hatched in those years (1 and 1927).

The results are shown as a diagram which dicates, besides the average number of verteb also the probable error of the averages. Altho the average varies from one year-class to ano it is always a little higher in the southern a This may possibly be connected with the fact



Average Number of Vertebrae in Norwegian Winter Herring from the west coast north of Bergen (N.) and south of gen (S.) in the 17 year-classes 1918 to 1934 from catches made in the fishing seasons 1932/33—1939/40. The width of hatched area along each of the two curves is proportional to the probable errors of the average number for each year-c

the temperature of the sea is found to be somewhat higher in the northern than in the southern area, the former being more directly influenced by the Atlantic water.

We have tried to account for the yearly variations of the average number which affect both areas. The available number of pertinent observations proves, however, to be inadequate as far as the period 1918—1934 goes. It is hoped that a better understanding of these and similar phenomena may be possible when the regular fortnightly observations at Sognesjøen (mouth of the Sognefjord) and east and west of Utsira (W. of Haugesund) have accumulated for some years together with further observations of the vertebral number.

The number of samples investigated during the 8 years has been between 30 and 50 each year and each sample has generally consisted of about 200 individuals.

The following table shows the number of individuals belonging to each of the year-classes considered for the two divisions of the coast (N. and S.) and also a figure (R) denoting the number of times the probable error of the difference between each year's average numbers in the N. and S. division is contained in this difference: $R = D/E$, where $E = \sqrt{n^2 + s^2}$, n and s being the probable errors of the two averages in question.

Year-Class	No. of Indiv.		R
	N.	S.	
1918	975	749	4·4
1919	79	31	1·5
1920	292	178	3·2
1921	380	207	3·2
1922	1,836	646	1·6
1923	2,963	1,550	6·4
1924	2,668	572	6·5
1925	3,186	1,307	5·5
1926	858	382	2·6
1927	157	52	0·1
1928	975	446	7·1
1929	894	444	3·6
1930	5,502	3,553	2·9
1931	962	446	1·9
1932	2,182	1,358	2·1
1933	1,095	756	1·9
1934	203	183	1·6
Tot.	25,207	12,860	—

The Fat and Small Herring on the Coast of Norway in 1940.

By

Oscar Sund.

NON-ADULT herring were much more plentiful in 1940 than for many years and this is the more evident if account is taken of the various difficulties which beset the fishing industry as a whole, especially a scarcity of fuel oil for fishing and transport vessels. The total output of 343,000 tons or nearly 3½ mill. hl. must therefore be considered very heavy.

Of this total quantity returned,

2,700,000 hl. were used for making oil and meal
297,000 „ „ „ or exported frish
260,000 „ „ made into "pickled fat herring"
108,000 „ „ canned
38,000 „ „ salted headed (as "cut herring")

The first of these items consisted mainly of the 0- and I-group, the "fresh" of the I-group and older, the "pickled" of the III-group and older, the "canned" of the I- and II-groups and the "cut" mainly of the II-group. The proportion of "fat" to "small", therefore, may have been somewhere near 550,000 hl. as against nearly 3,000,000 hl. "small". The geographical distribution of the catch in 1940 is shown on the lower inset, Fig. 8.

Compared with the catches during the preceding 12 years the catch of 1940 is seen to be very large and certainly indicates a larger inflow of herring than in 1933 even, the different conditions of work in the two years considered.

The figures show that the fishery during these years had small herring as its mainstay, the produce being for the greater part utilized for making fodder meal and oil. The herring meal and oil industry came into being about 1910, when the output of fat herring for a number of years had been poor and irregular, in sharp contrast to the conditions recorded during the latter half of last century. In those times the fat herring was regarded as the mainstay of economic life on large portions of the coast and, before all, in the county of Nordland which extends over 600 km. from N. to S. In Fig. 1 it is tried to render the available statistical data in a compact form so as to show the variations of output since 1879 and its distribution on the main divisions of where the most prolific fishery of young herring is carried on, i.e., N. of Cape Stat. Since the period before 1898 with fairly regular fat-herring fishery, these later year-classes

Table 1.

Year	Output and Use of Catch (,000 hl.)						Exports (,00 tons)			
							Fresh		Salt	
	Total	Fresh	Salt	Meal	Cann.	Cut	Fat	Small	Fat	Small
1928	2068	64	118	1442	382	24	88		60	40
29	1457	49	84	925	282	16	46		70	51
1930	995	26	83	745	63	10	45		84	31
31	686	27	48	368	196	4	20		70	24
32	1885	25	151	1464	154	19	83	33	70	20
33	3604	90	116	3140	125	5	180	43	97	18
34	2353	193	165	1789	130	19	220	37	81	20
1935	1757	103	77	1233	255	27	119	44	63	24
36	1466	150	132	800	232	16	121	98	52	18
37	1465	84	125	977	243	3	118	17	49	9
38	1403	114	40	1023	147	16	87	67	23	19
39	1550	154	54	1068	193	22	131	108	34	18
1940	3430	294	260	2700	108	38	82	231	96	33

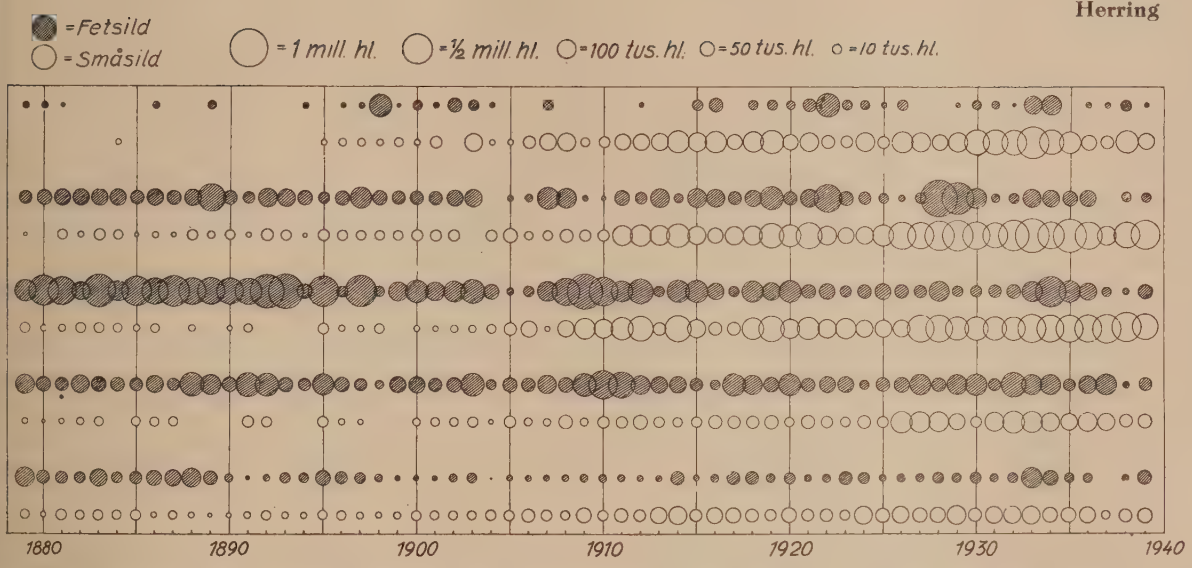


Fig. 1. Yearly Output of Fat and Small Herrings in the five Main Sectors of the coast N. of C. Stat 1879—1939, shown as *spheres*. (Scale above; Fetsild = fat herring, Småsild = small h.). See Fig. 3.

of young herring have made a notable appearance only occasionally, namely in 1909—10, 1928, 1934 and now in 1940. The output of this last year was severely restricted by causes entirely independent of the resources of the sea or the capacity of the fishery. When this is considered, it may be safely assumed that the 1940 influx of herrings, as well of the younger age-groups (I and II) as of real fat herring, was of an unusually great order though certainly not so heavy as in some of the years during the fat-herring period before 1900. At that time only land-seines were in use and the large quantities captured must therefore be measured on a different scale from the one to be used when considering the catches in modern times when the very efficient purse-seine is responsible for a large proportion of the output.

In 1940 the purse-seines, however, were seriously handicapped by a scarcity of fuel oil and the unusual formation of the herrings (to be described below) made the use of this gear difficult and the success of each haul very uncertain. The high prices prevailing most of the season, sometimes above 40 Kr. per hl. for herring large enough for salting, played a great part in keeping the fishing going. All along the coast bottom gill-nets as well as drift-nets were used and produced quantities of good herring of which a large proportion was certainly retained by the fishermen for their own or local consumption, thereby not appearing in the returns.

Table 2.
Fat Herring Samples 1940.

he order is from N. and southwards. "Div." refers to the fishery divisions, see chart, Fig. 3; "Gear" is either gill-net (g) or seine (s).

e Div.	Date	Place	Gear	No. of ind. Total	No. of ind. Read	Age in years 2	3	4	5	6	7	8	9	10	11	12	13	:::	19
35	5/9	Kvænangen	g	50	49	—	2	55	20	16	6	—	—	—	—	—	—	—	—
34	24/8	Kalfjord	s	99	95	3	86	7	—	1	2	—	—	—	—	—	—	—	—
33	16/5	Gryllefjord	s	104	79	4	9	3	17	63	3	—	—	—	—	—	1	—	1
28	19/9	Glåmfjord	s	198	197	9	89	1	—	—	2	—	—	—	—	—	—	—	—
23	7/8	Stjørna	s	100	91	—	80	1	1	3	12	2	—	—	—	—	—	—	—
22	26/9	Skeia	g	164	159	47	1	1	3	39	7	2	—	—	—	—	—	—	—
21	27/9	Årvågfjord	s	55	53	2	84	7	—	—	5	—	—	—	—	—	—	—	—
14	10/7	Bergen	s	100	93	99	1	—	—	—	—	—	—	—	—	—	—	—	—
14	23/7	„	g	144	140	—	—	4	4	16	46	14	8	4	1	1	1	—	—
14	26/10	Masfjord	s	100	96	96	4	—	—	—	—	—	—	—	—	—	—	—	—

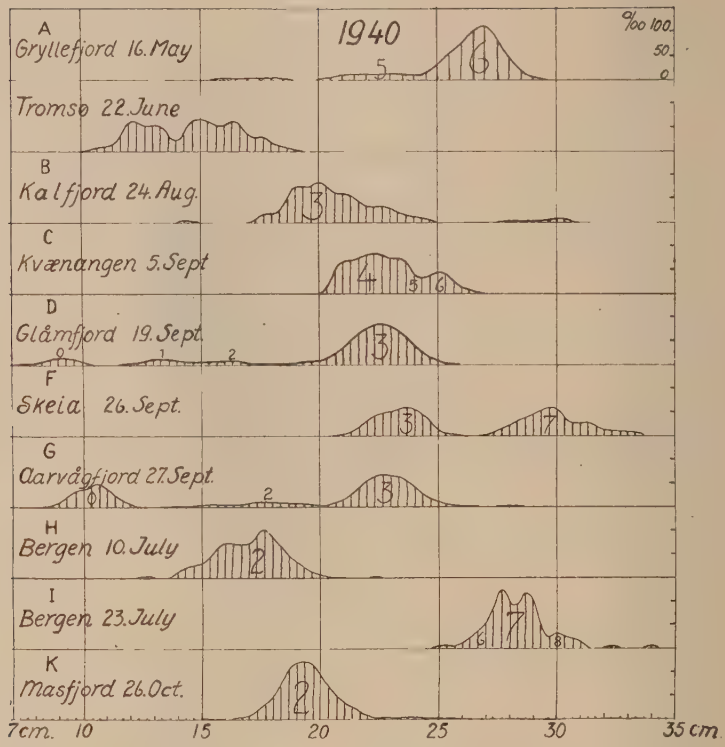


Fig. 2. Size-Distribution in Herring Samples 1940. All seine-caught except C, F and I. The predominating age-groups are indicated by figures inscribed within the curves.

The Size and Age of the Herring.

As seen from the above statement of the various uses of the catch about 85 % of it was made up of small herring, and only about 15 % of fish suited for salting or human consumption in the fresh state. This low percentage may, however, to some degree have been conditioned by a very general scarcity of barrels and boxes and even of salt owing to transport difficulties so that a larger proportion had to be delivered at the meal-and-oil factories than would otherwise have been the case. This refers only to the seine-("not")-caught part of the catch.

The majority of purse-seine catches consisted of small herring of the 0- and I-groups, some, however, of larger herring. A series af samples was obtained from different points, mostly seine-caught. The size-distribution of these is shown in Fig. 2. All samples were measured to the nearest third of a cm. except the first which was measured to the nearest ½ cm. One sample, E, was measured to the nearest cm. only and is not shown in Fig. 2 but considered in Tab. 2 which gives the age-distribution.

It will be seen that every size was represente As to age most of the herring salted belong to t III-group, but contingents of the IV-, V- and V groups were fairly numerous on the coast N. of t Trondheim fjord and the VII-group together wi the II-group on the S. part of the coast. The general conditions are also indicated on the small inset on the chart, Fig. 8.

The detailed age-distribution in the sampl investigated (A—K) is shown in the table belo expressed as percentages.

The Modes of Occurrence of the Herrin in the Sea as Revealed by Echo-Soundin

Not only with regard to the quantities of herri present in the coastal waters in the course of t year was 1940 outstanding, but also as to a near ubiquitous occurrence and to the peculiar charact of the shoaling which was conspicuously differe from the formations observed in the earlier yea since the research vessel ("Johan Hjort") was fitte with echo-gear (since 1935 incl.).

Extent of Investigation. Between Au

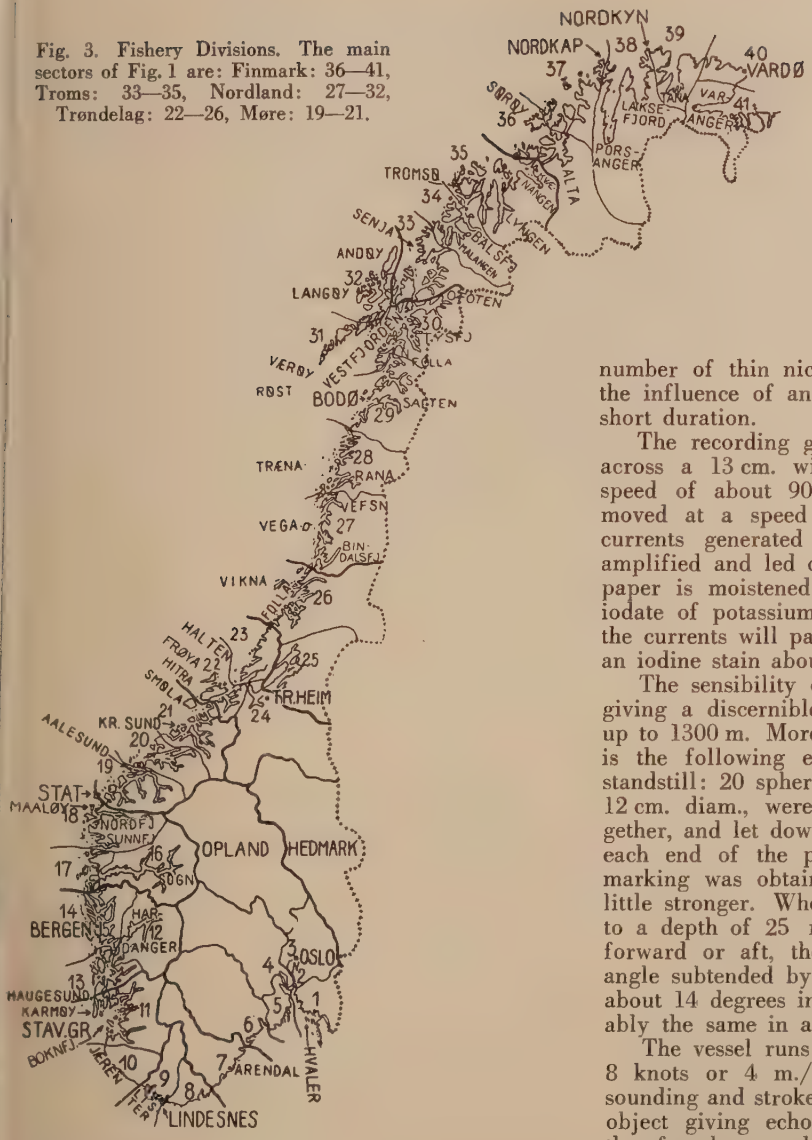


Fig. 3. Fishery Divisions. The main sectors of Fig. 1 are: Finmark: 36—41, Troms: 33—35, Nordland: 27—32, Trøndelag: 22—26, Møre: 19—21.

17th and Oct. 4th the coastal waters from Hammerfest to Bergen were investigated by echo-sounding in order to locate herring. The direct sea-road between these points has a length of 860 nautical miles of 1335 km. while the distances run by the "Johan Hjort" amounted to 2033 n. m. or 3765 km., the echo-gear running all the while.

Instrumental data. In order to appreciate the nature of the records obtained, it is necessary to note the following particulars: the instrument used is the Hughe's Admiralty gear which makes and records 75 soundings every minute. The sending and receiving organs consist of a great number of thin nickel plates made to vibrate by the influence of an electro-magnetic field of very short duration.

The recording gear is a metal style travelling across a 13 cm. wide paper band at a uniform speed of about 90 cm./sec. while the paper is moved at a speed of only 0·0085 cm./sec. The currents generated in the receiver are suitably amplified and led on to the moving style. As the paper is moistened and imbued with starch and iodate of potassium and runs over a metal plate, the currents will pass through the paper and leave an iodine stain about $\frac{1}{3}$ mm. wide.

The sensibility of the gear is indicated by its giving a discernible bottom curve over depths of up to 1300 m. More to the point in this connexion is the following experiment made with ship at standstill: 20 spherical glass floats, each of about 12 cm. diam., were fastened to a pole, close together, and let down under the vessel by a line at each end of the pole. A weak, though definite marking was obtained from 50 m., from 25 m. a little stronger. When the pole (with floats), sunk to a depth of 25 m., was shifted more than 4 m. forward or aft, the echo-mark disappeared. The angle subtended by the sound-beam is accordingly about 14 degrees in an fore-aft plane and presumably the same in a transverse plane.

The vessel runs with a speed of approximately 8 knots or 4 m./sec., viz., 3·3 m. between each sounding and stroke of the recording style. A small object giving echo from a depth of 25 m. may therefore be recorded by two echoes, from a depth of 50 m. by 5 echoes, the distances run being resp. 8 and 16 m. across the field within which the echoes from a small object will be able to affect the receiver. In the first case the width of the mark will not be much wider than from a single echo as the paper moves less than $\frac{1}{10}$ of a mm. per stroke, in the second case it will be visibly wider and approach $\frac{3}{4}$ mm. If the marks are wider than these "minimum marks", the echo-giving object cannot be "small" but so many times larger than 3·3 m. as the mark is wider than the minimum marks divided by 0·085 mm. A mark, 1 mm. wide, at 25 m. is therefore caused by an echo-producing object extending

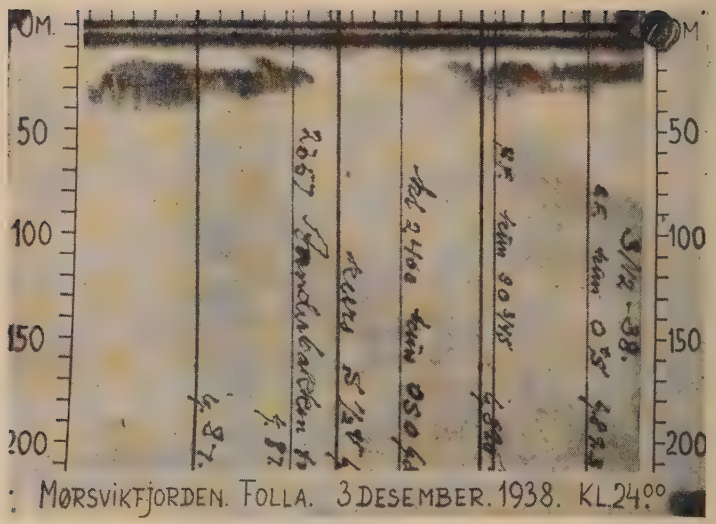


Fig. 4. Echogram showing dense Herring Shoal in Folla Fjord (Lat. 68N.). Along the upper edge are seen the minute marks automatically appearing for every 75th sounding. Below these is the zero line and below that, between 5 and 10 m. according to the scale photographed along with the echogram, an unavoidable spurious echo and below this two cloudlike shadows, caused by herring. The heavy vertical lines are the automatically registered signals from the electrical log, one for each naut. mile completed. The thinner lines are made at will to note time or place.

about 27 m. in direction of the course calculated thus:

3·3 m. (1 mm. — 0·7 mm.) /0·085 mm. = 27 m.

As the width of small marks cannot be measured

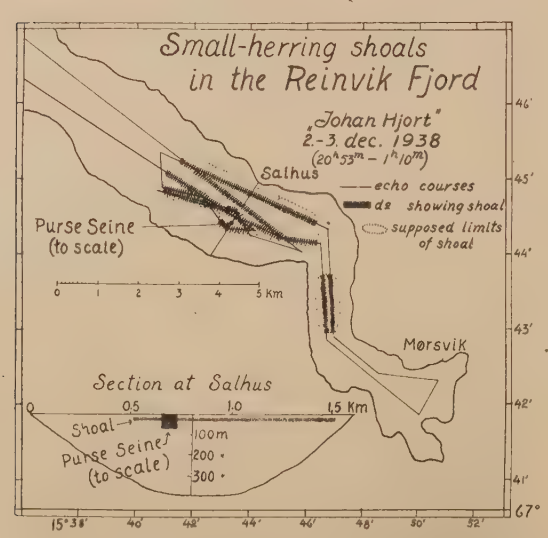


Fig. 5. Sketch Map constructed from Echogram, Fig. 4.

with any high degree of accuracy and is moreove affected to a varying degree by the quality of th paper and other such influences, the figure abov obtained must only be taken as an indication o the order of magnitude. All such considerations ar unnecessary when considering larger marks. Th width of these corresponds, of course, to the rea extension of the object.

Some earlier Herring Observation

The character of the echo-marks which in earlie years have been taken as representing small or fa herring have either been occasional small marks a great intervals, on the whole very rare, or they hav been marks of large extent, up to several km. a the one reproduced here as Fig. 4. The indication of this echogram (of which only a portion is show in Fig. 4) have been utilized for the constructio of the sketch map and section Fig. 5. Only on purse-seine was present at the occasion of the takin of the echogram. This seine made a catch we within the shoal, and its position and size is draw to scale. The operator of the seine declared tha his catch which actually amounted to 300 hl. woul have been twice this quantity but for a misha when drawing the pursing line. If this be so, th shoal which had an area of between 5 and 6 sq. kn must have contained some 700.000 hl., in any cas

half this amount. The catch proved to consist of small herring of the 0-, I- and II-groups.

Another example is given in Fig. 6 where the echogram, however, is rendered by a drawing, the courses of the vessel are shown in Fig. 7, where two shoals are indicated, one about 6 of 7 sq. km. and a smaller one of about 1 sq. km.

Observations in 1940. The search for herring by means of echo-sounding is mentioned above. The course was mostly laid along the inshore roadsteads and a number of fjords were investigated, but in some places the investigation was carried some distance out to sea, namely the whole stretch outside divisions 34, 35 and 36, and a short trip outside division 27 while shorter distances of open sea have, of course, to be crossed at several places (div. 32, 31, 26, 21, 19—18), see sketch map Fig. 3.

The echo charts were subsequently examined and the number of naut. miles where one or more marks had been registered as well as the number of marks were counted. The details of this count are given in the table below. Some of the divisions are (more or less arbitrarily) divided into an inner and an outer portion and the results given separately for these.

As will be seen the lengths of sounding courses run in each division were different, most work being applied to those divisions where the fishing activity was liveliest. Unfortunately the data on the catch within the several parts of the coast are only available for much larger districts than the fishery divisions and a close comparison between the results

Table 3.

Echo-Sounding for Herring 1940.

Dates	Distr. inner or outer pt.	Naut. miles run	No. of miles showing herr. < 20 m.	No. of miles showing herr. > 20 m.	Number of herr. marks < 20 m.	Number of herr. marks > 20 m.	Mean distance (m.) < 20	Mean distance (m.) > 20
17 Aug.	35 In	50	25	10	111	47	515	392
18 „	35 Ou	71	34	44	227	699	277	116
18 „	34 Ou	114	65	31	607	127	198	453
19—21 „	34 In	80	1	2	7	8	265	463
26—27 „	35 In	119	9	0	33	0	505	—
28 „	36 Ou	45	0	0	0	0	—	—
29—30 „	36 In	81	24	0	164	0	272	—
30—31 „	37 In	88	15	4	74	11	375	672
2 Sept.	36 In	35	20	10	188	35	198	527
4 „	36 Ou	44	23	6	113	18	376	617
5—7 „	35 In	130	75	16	609	27	228	1095
9 „	34 In	13	7	0	44	0	294	—
9—10 „	33 In	82	35	7	215	12	302	1080
10—11 „	32 In	43	17	3	74	8	425	693
11 „	32 Ou	23	2	1	10	3	370	617
11—12 „	31 In	31	1	0	4	0	462	—
12—13 „	30 In	32	10	5	107	14	174	663
13—18 „	29 In, Ou	159	117	62	1386	445	157	258
19—20 „	28 In	110	84	25	547	90	284	520
21 „	27 Ou	43	15	10	80	24	348	780
21, 23 „	27 In	53	39	11	317	28	228	730
23, 24 „	26 In	85	39	15	216	36	335	767
25, 26 „	23 In	62	27	13	181	29	276	830
26 „	22 In	33	5	4	21	67	440	110
26, 27 „	21 Ou	38	1	3	2	10	900	555
27, 28, 29 „ 1, 2 Oct.	21 In	178	43	13	138	19	575	1260
2 „	20 In	44	8	10	16	27	930	688
3 „	19 In	51	6	8	21	22	530	675
4 „ 4 „	18 In 17 In	96	51	9	407	23	232	726
	Total	2033	798	322	5930	1829	—	—

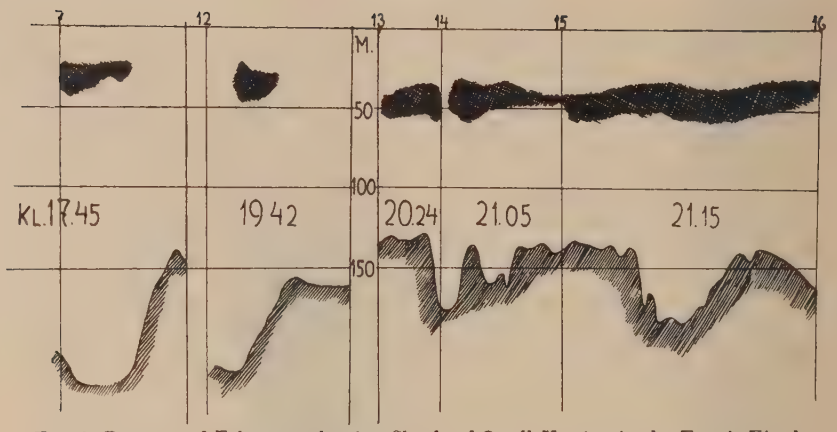


Fig. 6. Drawing of Echogram showing Shoals of Small Herring in the Femris Fjord, Oct. 11th, 1939. The larger figures are the time, the small top figures correspond to the points shown in Fig. 7.

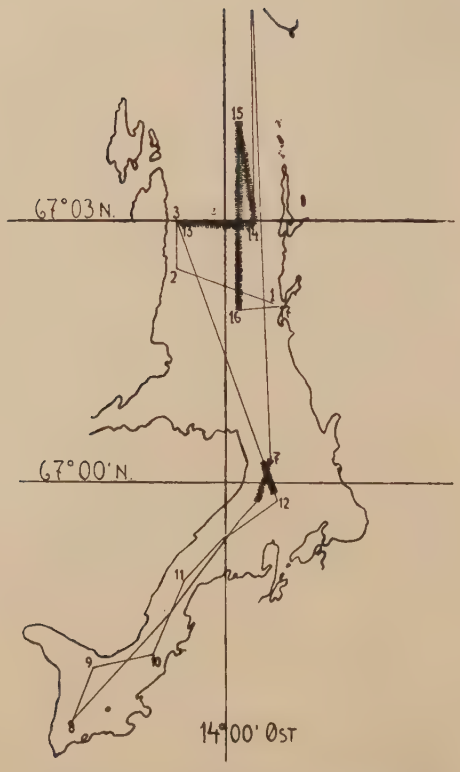


Fig. 7. Sketch Map corresponding to Echogram, Fig. 6. The hatchings show where the courses went over herring shoals.

of the fishery and the echo search cannot be don
It seems, however, from the disproportion betwee
the comparatively large catch in the Div. 19—2
and the relatively few echo-marks in the sam
divisions, one of which (21) was searched ver
thoroughly, that the resources of the sea wer
sufficient everywhere to yield satisfactory catche
See Fig. 8.

The Mode of occurrence in 1940. I
was mentioned above that the formation of th
herring met with in 1940, was very different fro
that encountered in the earlier years from whic
echo observations are available (1935—39). Ty
pical examples of such earlier observations ar
given in Figs. 4 and 6. A few examples from 194
are given in Figs. 9—16. It is seen that the herrin
this year occurred only as very small patche
distinctly separated from each other, often by ver
short distances of only a few metres. If two mark
at 20 m. are distinctly separated, the echo-givin
objects must lie at least about 6 m. apart, i.e., abou
twice the distance run between two soundings. I
many other cases the distance between two patche
was several hundreds of metres.

Over most of the distances covered, the herrin
were found between 10 and 20 m. but here an
there marks were observed also between 20 an
50 m., scarcely any at deeper levels.

General View of the Echo Results
In order to reduce the great mass of observations t
some sort of general view, we have tried two ways
(1) the number of naut. miles (which are automatic
ally marked off on the echograms) showing an
herring marks have been counted, and (2) the tota
number of marks have also been counted. The sketc
map Fig. 8 visualizes the proportion of miles wit
herring marks to the total distance run, separatel

Fig. 8. Main Chart showing proportional No. of Miles with Herring Marks in 0—20 m. (shaded) and in 20—50 m. (black). Full circle 100 %. Distance run in each division shown by rings around symbols, a full ring equals 100 n. miles. Upper inset: predominating ages in samples 1940. Lower inset: output of fat and small herring in 1940.

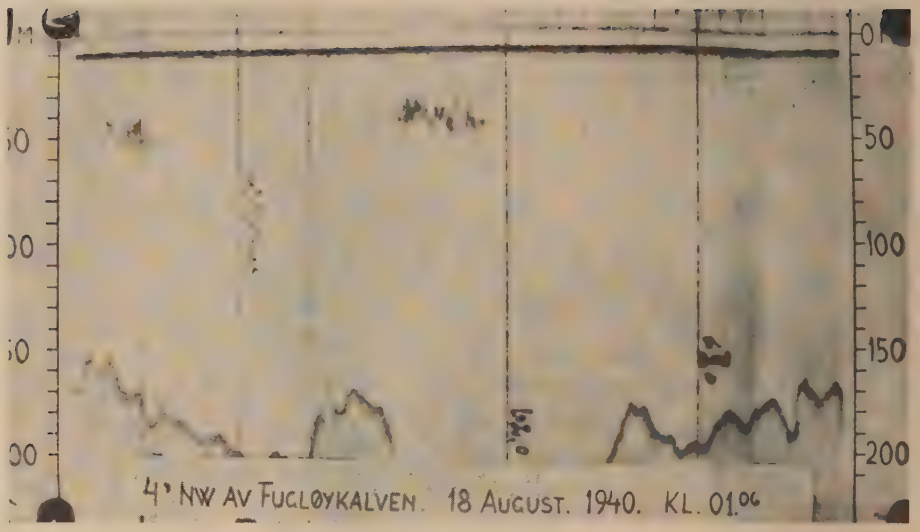


Fig. 9.

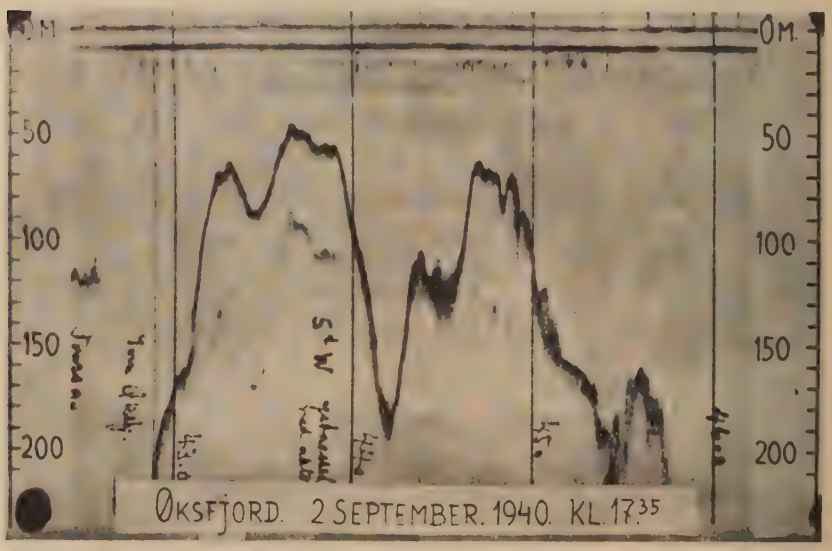


Fig. 10.

Echograms showing Herring Formations typical of the year 1940.
For explanation see Fig. 4.

for the levels between 0 and 20 m. and deeper than 20 m. As remarked above, one might as well say 10—20 m. and 20—50 m. since marks were utterly scarce above 10 or below 50 m. The percentage so found is symbolized by an angle, 100 % being made equal to 360°. The distance actually run is shown as rings around the symbols, a full ring for each 100 naut. miles. Some of the divisions were searched twice at a few days interval. These results have been combined in the sketch map but are kept apart in the table.

The count of marks has been used for calcula the average distance between marks. These fig are given in the last two columns of the table, figures in Col. 8 being the quotients between t in Col. 6 and 4, the figures in Col. 9 are quotients between the figures in Cols. 7 and 5.

Even when fully aware of the inherent weak of such averages which conceal so much of actual facts, these average figures still conve general idea of the extreme patchiness of occurrence. It seems to be significant that

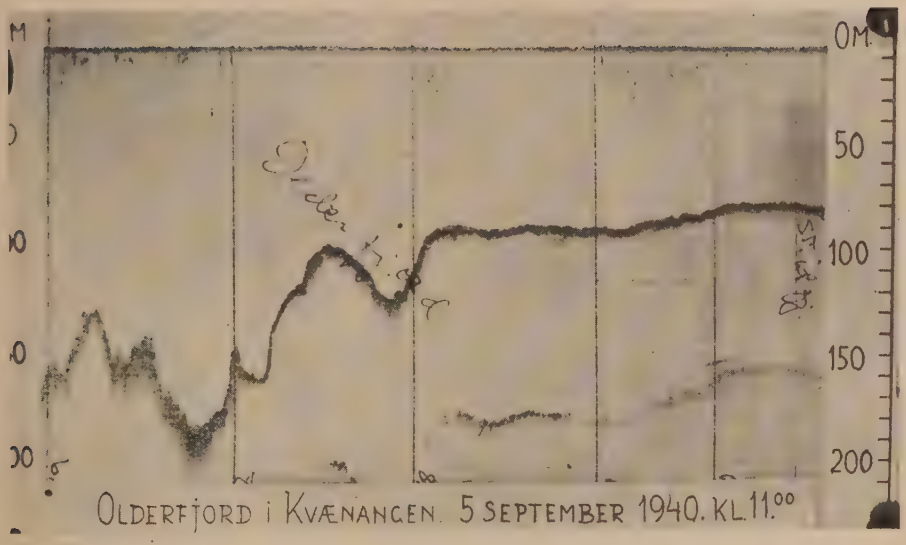


Fig. 11.

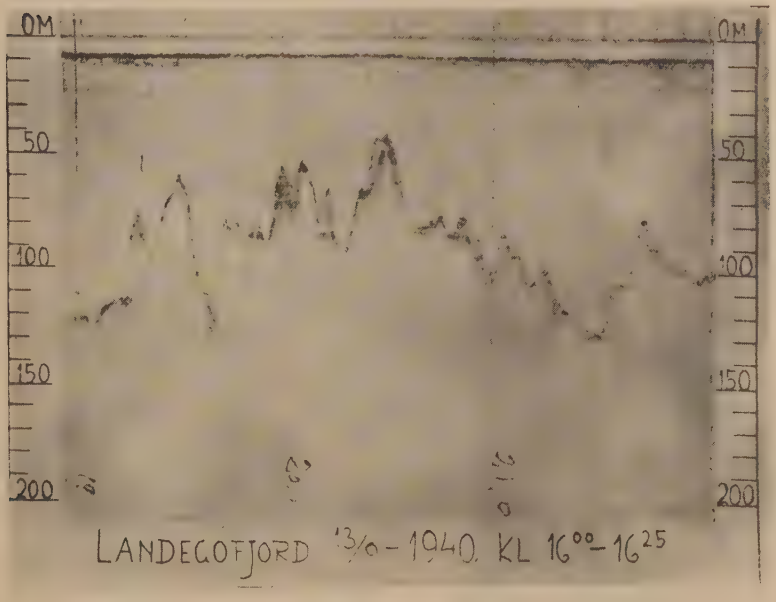


Fig. 12.

Echograms showing Herring Formations typical of the year 1940.
For explanation see Fig. 4.

average closeness of marks at the deeper levels in Div. 22 coincided with a remunerative gill-net-fishing producing herring of the larger sizes such as sample F, Fig. 2, while the small average distance between marks at the upper levels in Div. 28 and 29 coincided with many small purse-seine catches of the younger year-classes as found in sample D, Fig. 2.

Size of Catches. On the cruise information was collected regarding the catches made at the time or just before the visit of the research vessel. Though necessarily of a casual character, this information is thought sufficiently interesting as an indication of the importance to be attached to the types of formation met with on the cruise.

1) In Vargsundet (Alta, Div. 36), Sept. 2nd, a catch of 3 hl. in two drift-nets was reported. The formation of echo-marks was at the time as shown in Fig. 9.

2) In Kalfjord (W. of Tromsø, Div. 34), Aug. 18th,

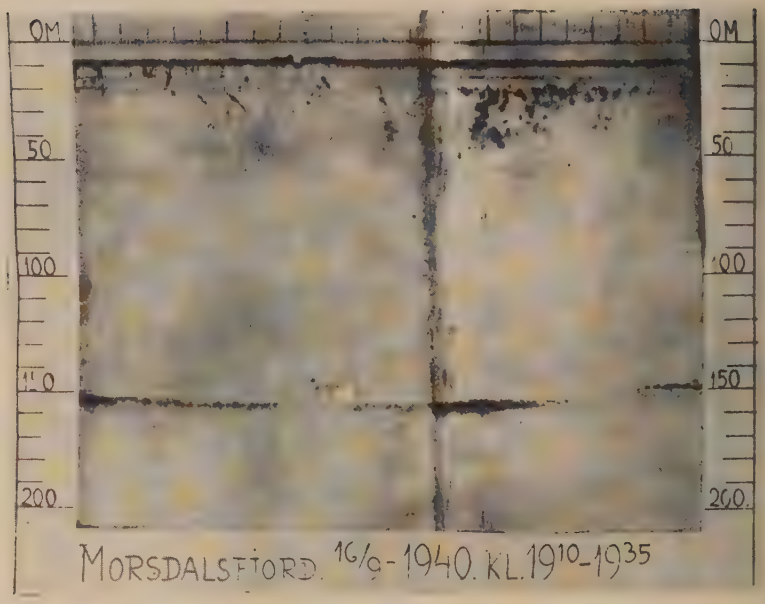


Fig. 13.

Fig. 14.

Echograms showing Herring Formations typical of the year 1940.
For explanation see Fig. 4.

small drift-net catches, very dispersed formation.
3) Salten fjord (Div. 29), Sept. 17th, many drift-net catches, averaging about 60 litres per net. Echo-marks as in Fig. 9 or *less* dense.
4) Bight S. of Kunna (Div. 28). Sept. 18th, one purse-catch the day before. At the spot only a small echo-mark at 50 m.
5) Glåmfjord (Div. 28). Sept. 19th. 4 purse-catches of resp. 3, 12 and 14 hl. Formation of same ch ter as in Fig. 9.
6) Bjugn (Div. 23), Sept. 25th, many dri obtained catches of 3—4 hl. per 20 nets (sunk) Formation as shown in Fig. 15.
7) Skeia (Div. 22), Sept. 26th, one boat go litres in 10 nets. No marks in the vicinity.
8) Vikhals in Aure herred (Div. 21). Sept.

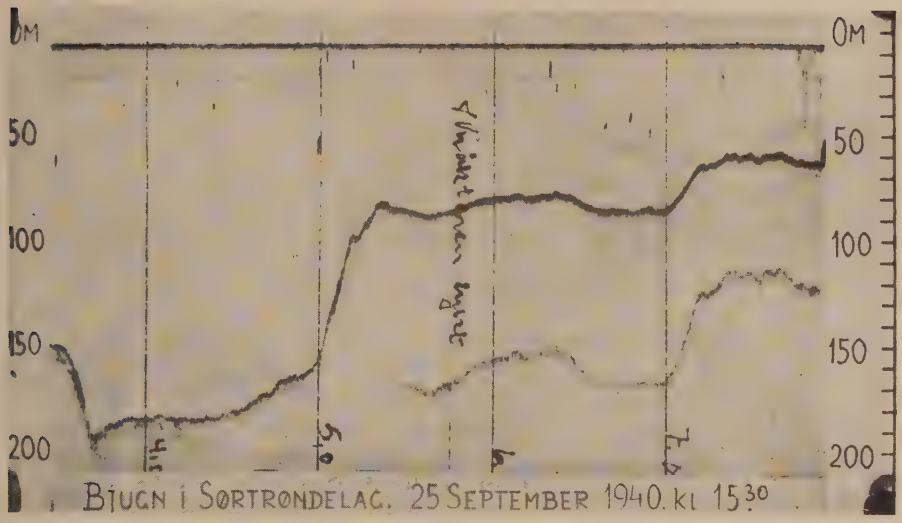


Fig. 15.

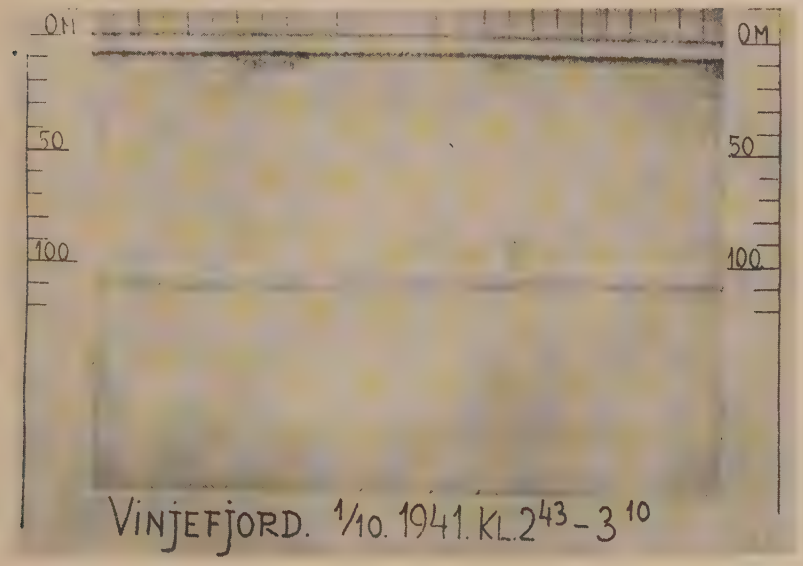


Fig. 16.

Echograms showing Herring Formations typical of the year 1940.
For explanation see Fig. 4.

In the herred Aure, which comprises an aggregate fjord-length of about 40 km., the output during August and September amounted to about 7000 hl. At the time only very few marks were obtained. Later on some purse-seine fishing was, however, done.

9) In the Vinjefjord in the same neighbourhood a purse-seiner stated "that 10 purse-seines were working in this small fjord, last night, they got 40—150 hl. each in two hauls. About 15 % of the catch large enough for salting. On account of very strong phosphorescence, the herring did not touch the brass wire used for detecting them and the throwing of the nets had to be made only by observing the patches of light emitted by the plankton when disturbed by moving herring." Fig. 16 is an echogram taken while at a stand-still.

Influence of Light. It was expected that the herring would be influenced by the variations in daylight in its vertical movements. This appeared, however, not to be the case. During the first part of the investigations, these were carried out by day

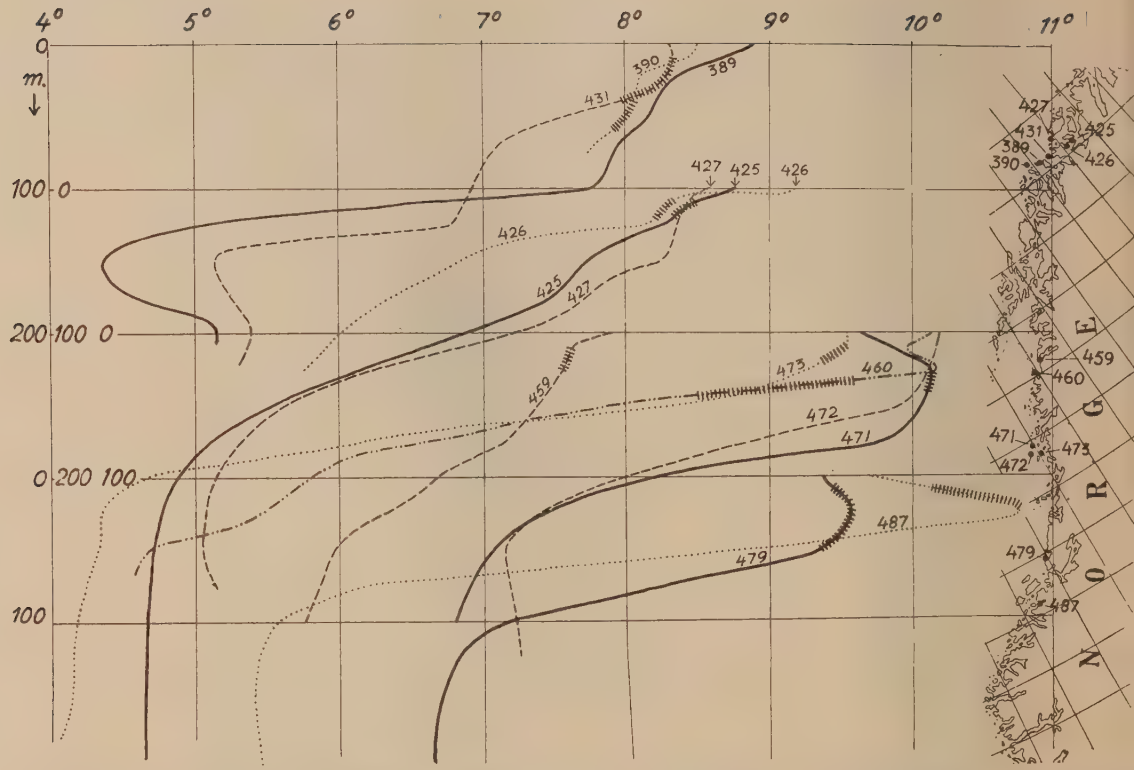


Fig. 17. Typical Temperature Curves from a Number of Points along the Coast in Aug.—Sept. 1940. The position herring in the water is indicated by hatching the corresponding part of the curve. The following stations are situat in the open sea: 390, 427, 431, 472, the others in more or less sheltered water.

and night, but no difference was observed in the level of the herring marks. Fig. 9 shows one of the densest formations observed on the cruise and was obtained at midnight Aug. 18th, at Lat. 70° N., when the light was much too weak for reading and the sky overcast. In this case most of the herring appeared to have gathered between 30 and 50 m. Most of the occurrences of herring observed were, however, at higher levels than this during full daylight, generally at 10—20 m. On the other hand, the non-appearance of herring marks during daylight is no evidence against the presence of herring which may be so dispersed as not to show up at all. A positive proof of this was obtained in the Femris fjord in the autumn 1939. During several days in succession the fjord was searched for herring without any indications during daylight, but every night after sunset, a large shoal appeared as shown in Fig. 6 and 7, every time in very much the same position.

It is, therefore, most likely that the occurrence in echo-giving density at high levels during daylight, must be regarded as exceptional, and peculiar to the conditions prevailing in 1940.

Hydrographical Conditions. As r gards the general conditions, see Eggvin "Th Great Exchange of Water Masses along the No wegian Coast, 1940", in Rapp. et. Proc. Verb., Vo No. 112, p. 49. Here it suffices, therefore, t mention that the herring was observed always t keep to the layer above the thermocline or to th upper part of it as shown in Fig. 17, which give temperature curves for a number of typical place Herring Food. The occurrence of zoo plankton was investigated by means of vertica hauls from 100 m. or more to the surface by mean of the net "0/100" or egg-net, Diam. 100 cm. Th result can be summed up in a few words: nowhe was any appreciable quantity of copepods o euphausids found. The herring caught was empt and the flesh white showing that no or next to n food had been taken for some days. There mus however, have been much of the smaller plankto as the phosphorescense of the sea was noticed to b very strong in places, in one place at least s much so that it constituted a difficulty for th fishing. The transparency was, therefore, muc lower than would be expected from the very scant

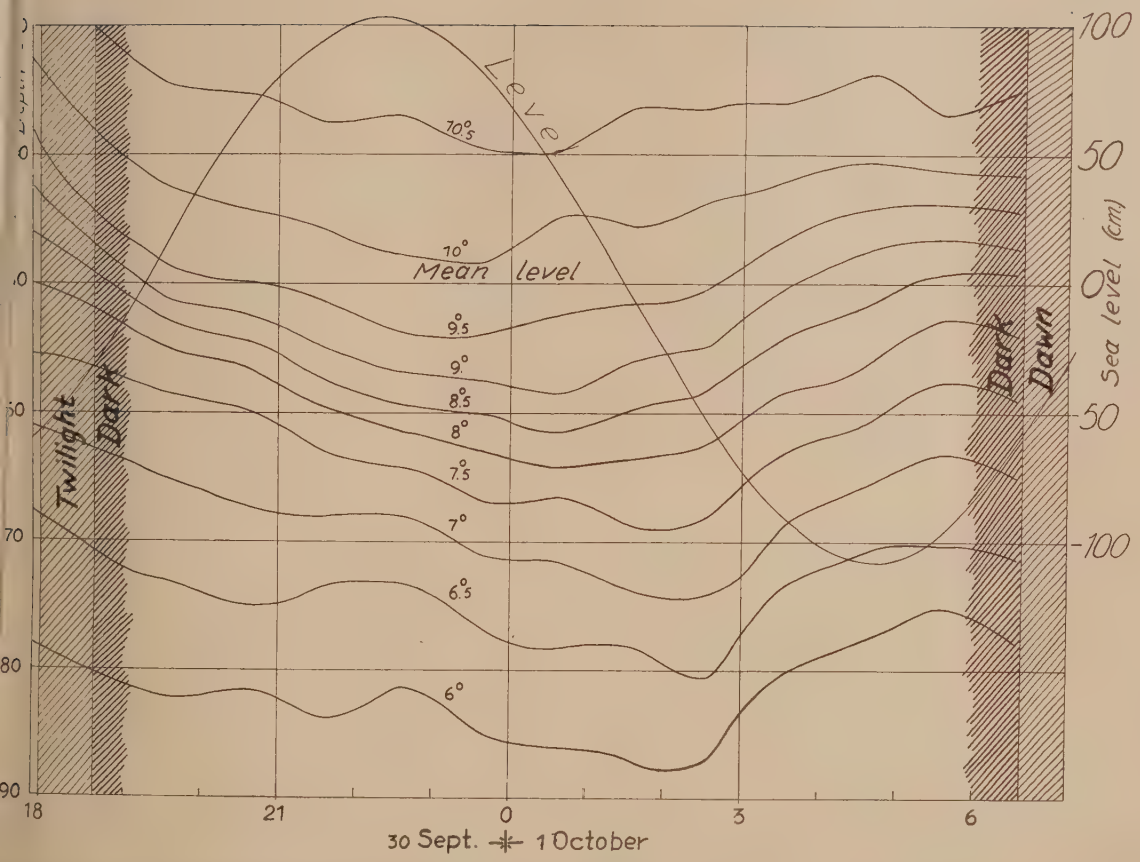


Fig. 18. Hourly Observation of Temperature at 10 Depths at Vinjefjord, the vessel anchored in 110 m. of water. the thin line across the isotherms is the water-level calculated from the tidal predictions (flood heights and hours) of the Sea Charting Department.

catches in the net "0/100" which lets through all organisms smaller than about ½ mm. The Secchi disc could be seen at 8—14 m., the higher figure being generally found nearer the open sea although comparatively high transparency was observed in some fjords also.

Possible influences on the Movement of Herring. As a general rule the densest congregations of immature herring are found in the inner parts of fjords and bights, while adult (winter) herring may also be observed in dense formation of great extent in the open sea outside the coast. The dense occurrence of smaller herring in fjords and bays is generally accounted for by the supposition that the herring at this stage is moving "in search of food". Instead of entering upon a discussion of the difficulties connected with the conception of a fish like the herring searching for food over wide distances, it is sufficient to point to the fact that the herring food actually present in the inner waters at the time when small and fat herring are most plentiful, is very scant indeed.

It may, therefore, be considered of some interest to try to point out some influences which may be more easily conceived as influencing herring movements.

First of all one is led to think of the tidal currents caused by the comparatively strong tides along the whole of the "fat-herring coast", about 1 m. in the Stat region and 1½ m. in the whole of N. Norway above and below the mean level. The currents set up by these movements affect especially the upper layers as an ingoing current with rising and outgoing with falling level while weaker currents of opposite direction are generated in the depth.

During the cruise an opportunity offered itself of observing this phenomenon in the Vinje fjord (Div. 21, Fig. 3) by hourly repeated observation of temperature at 10 standard levels while at anchor

in 110 m. The results are shown in Fig. 18 giving the positions of a number of isotherms during the night as well as the predicted sea level. (The last-named is assumed to correspond closely to the actual level since the air pressure was normal and only moderate wind was blowing).

As will be seen from Fig. 18 the upper layer was increasing in thickness till somewhat after midnight and the current in this layer therefore ingoing. As the herring will, as a rule, rise at nightfall, they would thus be carried towards the inner parts of the fjord. If now daylight sets in before the current is reversed, the herring will sink and thus remain in the fjord, their number being augmented during the next night. This will be the general course of events at full moon and at new moon, while a neap tides the effect will be th reverse. This is in good accordance with the gener confidence among the fishermen about improveme of the fishing conditions towards full and especiall new moon. In the latter case the nights will b even darker than usual, not even the moon pr venting the herring from rising.

The explanation which is tentatively offere here has, at any rate, the merit that it can be teste by observable events. Such a test cannot, howeve be carried through by means of the very scant commercial fishery data as hitherto collected, no by the necessarily casual observations on a crui along the coast but only by watching the even throughout a successful fishing period in suitabl localities.

North-Western Area.

Introduction.

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Dr. Adolf Kotthaus, Wesermünde,
Dr. Å. Vedel Tåning, Copenhagen.

DUE to the abnormal conditions prevailing throughout Europe several members of the North-Western Area Committee have been prevented from contributing to this report, and the items included in the report are thus insufficient to give an all-round impression of the features concerning the important food fishes in the area as well as the several other phenomena involved in the studies of the sea. Contributions from Scottish quarters on Faroe haddock and herring, English measurements of halibut, comprehensive planktonic, hydrographical and meteorological reviews etc. are *inter alia* lacking. Moreover reviews of results from studies several years back, e. g., on age composition, growth etc., are only given for some few fishes.

An outstanding characteristic of the year, as against all recent years (probably in this century), is the colossal influx of warm Atlantic water into the Iceland area. It was evident that the influx of water and the rise in temperature had an enormous effect on many of the biological features investigated; this will easily be seen from various information given in this report, e. g., the drift and growth of the cod and haddock fry, the early appearance of 0-group halibut in Faxa Bay and so on. It is deplorable that continuous studies of these phenomena, hydrographical and biological, have been cut off, as the information obtained by studies of extreme warm years in this arctic-boreal area may be considered of special value to the understanding of the features observed during normal years.

As to studies of the **bentonic animal life** in the area we have for the year 1939 only research work from Iceland waters; the material has, however, already been published, whereas reference to the paper may suffice (H. Einarsson: "Survey of the bentonic animal communities of Faxa Bay." Medd. Komm. Danmarks Fiskeri- og Havunders., Ser. Fiskeri, XI, Nr. 1, 1914).

The short reviews of the various contributors summarize the results obtained on the actual stocks of various important species, and other questions on the life history of the species are considered briefly where material at hand permitted. We will here shortly emphasize the more remarkable facts of the reports.

Herring: Studies on the stock of this important species have been commenced on a much broader basis than before. The rise in size of *spring spawners,* dominating about 34—35 cm. off north Iceland during the very rich herring-year 1937 has been conspicuous during 1938 and 1939 with a surplus on 36—37 cm. (Fig. 9). And a new maximum seems to emerge. Studies on size etc. of the spring-spawning herring have been carried out, not only on the north coast, but also off south-west Iceland (Table 6); and here the *summer-spawning stock* has been considered also (Table 7). The distribution and size of *pelagic fry* of the last-mentioned race were studied in late July, when the maximum in number of post-larvae was found west of the Westmanna Islands (Fig. 10), whereas few were obtained off south-east Iceland, where much fry had been observed in some previous years. No important results are available as to the Faroe stock of herring or postlarval stages (Fig. 1).

Cod: Material for age-assessment from commercial catches has been secured at *Iceland* and *Greenland* for studies on the composition of the stock. Medium-sized cod are scarce off Iceland (year-

classes 1925—29), whereas we have here several good year-classes of codling, especially off NW., N. and E.-Iceland, that are of growing importance to the fishery. At *Greenland*, however, several good year-classes, also some older ones, are present in the material from 1939.

These features are shown by the following small table (see Figs. 12, 13 and 24 and annexed tables).

Predominating year-classes in Greenland and Iceland cod catches in 1939.

West Greenland :	1922	—	1924	—	**1926**	—	—	1929	—	**1931**	**1932**	—	**1934**	—	—
Iceland SE.:	—	—	—	—	—	—	—	—	—	—	—	1933	**1934**	1935	—
S.:	—	—	—	—	—	—	—	—	1930	1931	—	—	—	—	—
SW.:	—	—	—	—	—	—	—	—	—	**1931**	—	—	—	—	—
NW.:	—	—	—	—	—	—	—	—	—	—	—	—	—	**1935**	1936
N.:	—	—	—	—	—	—	—	—	—	—	—	—	—	**1935**	**1936**
E.:	—	—	—	—	—	—	—	—	—	—	—	—	**1934**	**1935**	—

The old rich year-classes (1922, 1924, 1926) are yet of some slight importance in the *Greenland waters*, rapidly decreasing, however, during recent years, and being substituted — after a series of some rather unimportant year-classes — by several new good ones, the best of which seems to be that of 1934. In *Iceland waters*, more heavily fished than Greenland waters, on an average much younger year-classes are dominant, among which the broods of 1934 and 1935 are the best. The spawning localities off south and south-west Iceland being frequented by older year-classes, especially that of 1931; marking experiments in Greenland waters show that a strong emigration of this year-class has taken place to Iceland waters, emphasizing the importance of the interchanges between these two areas.

From *Faroe waters* no material is available from 1939 owing *inter alia* to the bad fishery of that year; a review of results previous to 1939 is given (see Fig. 2). From this area experimental trawlings, however, have shown that the larger codling of the stock have disappeared during recent years, small codling only being left by the intensive fishery (Fig. 3).

The growth of the individual year-classes of cod is shown (Table 20) for a long series of years for the stock of cod inhabiting the West-Greenland waters. Moreover the *size-distribution* of cod in German commercial catches from *Iceland* waters has been given from the two seasons 1937—38 and 1938—39 (Fig. 19), and it is to be hoped that a continuation of these measurements will be of much value to the future studies of the Iceland—Greenland cod population.

The extensive influx of warm Atlantic water during 1939 has accelerated the growth of the fry far beyond the normal of the season; this is shown on a chart (Fig. 14) representing the results from the cold year 1938 and from the warm year 1939. Drift of cod-fry towards the East-Greenland coasts seems to have been slight during 1939, coinciding with the strong influx of water to the north Iceland.

A few notes have been given on *marking exp ments* in Greenland—Iceland waters; on these periments publications are in preparation. experiments in Faroe waters during recent ye have but recently been reviewed by T å n i n g *Meddelelser fra Kommissionen for Danma*

Fiskeri- og Havundersøgelser (Fiskeri, Vol. X, Nc 1940).

Haddock: Regarding the stock of haddock in area information is available only from *Icel* (Table 12); here the broods of 1931, 1935, 19 and 1937 are predominating, that of 1936 estimated to be the best. Remarks on the *drift growth of fry* in 1938, and 1939, show that influence of temperature and current has hac similar effect on the growth of the fry as on t observed in the cod. In the period of experime carried out in 1938, fry of haddock was howe not secured off the north coast; the lack of fr probably caused by the low temperatures here, th being unfavourable to the fry of this species wh is a little more warm-loving than the cod.

The *size-distribution in commercial catches* fr German trawlers (Fig. 20) has been given 1937—38, and 1938—39, from Iceland, showing well-known difference in the composition of stock in the various areas round Iceland; m variation in the strength of the various year-cla is evident.

Saithe: Age composition of *Iceland* catches is gi (in Table 13), showing not less than 25 year-cla represented. As the study of the age composit of this species has just been inaugurated, we h to await subsequent results to see the influence fluctuations in the age composition of the st fished. The *size-distribution in commercial catc* from German trawlers has been given for the ye 1937—38, and 1938—39, from Iceland (Fig. 2 The curves are rather similar for the two seas some difference being present on the west and coasts. As the stock is composed by many ye classes, fluctuations are not so pronounced as several other species, e. g., the haddock. As studies of the saithe from the *Faroe area* we r refer to a paper just published, especially on young saithe in Faroe waters, by E. B e r t e l s (in Medd. Komm. Danmarks Fiskeri- og Havunde Ser. Fiskeri, Bd. XI, No. 2, 1942).

ak *(Gadus ogac):* From the *West-Greenland* ters several informations on this arctic fjord-cod e given, the age composition, growth and racial aracters being considered (Tables 22—25 and g. 26); of special interest is the fact that the best ar-classes correspond to those of the cod.

aice: Information on the *age composition* from e *Iceland* area is given (Tables 14—17 and Fig.); this area being the only important fishing ound for this species in the North-Western Area. ne year-class 1935 was during 1938, and 1939, by r the most prominent in the area, and nearly on l coasts (on the east coast however together with o other year-classes).

alibut: From the *Faroe area measurements* of ommercial catches from 1938, and 1939, are given Fig. 4); a short review on the *marking experi-ents* in these waters is included, showing the high ercentage taken of the very young year-classes of ne halibut stock. The *emigration* of young halibut other areas is not specially considered as many f the facts obtained have been reviewed recently y T å n i n g in the *Journal du Conseil* (1938).

The age composition in the stock of *Greenland* alibut is given for some years back (Fig. 26), howing an interesting similarity of predominating ear-classes in both cod and halibut. I have pre-iously drawn attention to this fact observed in celand—Greenland waters, and Mr. P a u l M. H a n s e n has now demonstrated that also the reenland fjord-cod *(Gadus ogac)* shows a certain similarity to the cod in this respect. The following small table gives the data at hand from West-Greenland waters:

Predominant year-classes in West-Greenland waters.

Halibut	1917	1922	1924	1926	1929	1931	?
Cod	1917	1922	1924	1926	1929?*)	1931	1932
Gadus ogac	?	?	?	1926?	1929	1931	1932

*) Year-class 1929 the best in southern Greenland between 1926 and 1931.

A general factor (whichever it now may prove to be) may be assumed to be operating in these cases, and it is worth of notice that the factor is operating in approximately the same direction in all these three species with very different spawning habits and of which the fry during the ontogenesis behave very differently: 1) a fjord- and coastal-spawning species *(Gadus ogac)*, 2) an off-shore-bank-spawning species *(Gadus callarias)* and 3) a deep-sea-spawning species *(Hippoglossus hippoglossus)*.

Greenland Halibut: For the first time a review of the results of *marking experiments* on about 1100 specimens in Greenland waters has been given, showing the fairly high percentage of recaptures on the banks and in the fjords where Greenlanders are fishing (Tables 28 and 29, Fig. 27). No long distance migrations have been observed; when maturing the species leave the coasts for the very deep waters in the Davis Strait where no fishing takes place (according to investigations by A d. S. J e n s e n).

Capelin *(Mallotus):* This very important species has been reviewed as to racial characters, size and age composition on material secured during the years 1933—1939 (Tables 30—33, Figs. 28 and 29). The facts recorded here for the first time call upon a thorough investigation of this species in all arctic-subarctic waters on the same lines as those on other important species of fish serving as food to man or marine animals.

Norway Haddock *(Sebastes):* The *size distribution in commercial catches* of German trawlers has been given for the years 1937—38, and 1938—39, for the Iceland area (Fig. 22). The size of the stock fished is very uniform, both as to areas and as to years; the predominating sizes are those between 35 and 45 cm. This had to be expected owing to the many year-classes involved and to the general life history of the species.

Å. V e d e l T å n i n g.

Remarks on the Influence of the Higher Temperatures in the Northern Waters during recent years on Distribution and Growth of some Marine Animals.

During recent years several authors have pointed out that they have observed a certain correlation between the somewhat higher temperatures observed in northern waters and the temporary occurrence of various southern pelagic and bottom animals not previously recorded in northern waters, or an increase in the stock of various boreal animals in certain arctic waters and a simultaneous decrease in the stocks of some arctic animals in the same waters. Many examples have been mentioned by several authors in papers of some length or in notes given in various periodicals. Reference has to be made here especially to a paper by Sæmundsson, 1934, in „Scient. Rep. of the North-Western Area Committee" (Rapp. et Proc.-Verb., Vol. LXXXVI, I), and a paper by Ad. S. Jensen, 1939 (Biol. Medd. of Kgl. Danske Vid. Selsk. XIV, 8).

The year 1939, seems in Icelandic waters to be quite exceptional in respect of high temperatures in the sea, these being much higher than in any other year of which we have information from this century, and in accordance with these higher temperatures we find that the seasonal distribution, growth etc. of the fry of certain species of fish has been altogether different from "normal" years. These features have been briefly summarized in the present reports on several of the important species of fish, e. g., cod and haddock. It will, however, be worth while to mention a few other scattered records from recent years concerning this matter from the various areas of the North-Western Area.

Already in 1938, during the Gulf Stream survey of the "Dana" of the waters west of the Faroes and the British Islands, it was observed that various pelagic animals of southern origin occurred farther north than previously seen; *inter alia* it should be mentioned that two specimens of *Velella spirans* were taken as far north as 60°10′N. Lat. 17°44′ W. Long. on June 28th; this species has never before been recorded so far north, the most northerly record being the Outer Hebrides, from which Frost (Scot. Nat. 1938) has a few records, also from later years, i. e., 1935 and 1937; at the south-west coast of Great Britain this species has been recorded now and then according to Russell and Kemp (*Nature*, Oct. 1932)*).

From the Faroes a few records of southern species of fish may be mentioned from recent yea *Mugil chelo* is here of very rare occurrence, was recorded now and then in stray specimens or small shoals in the years 1935—38; in 19 however, the species was abundant, and hundr were caught. *Gaidropsarus mediterraneus* has ne been recorded previously so far north as the Faro but was taken here in August 1937. *Molva elong* has, as far as known, never been recorded north the waters south-west of Ireland; this species w caught on the Faroe Bank on August 23rd, 19 (a young specimen).

From the *Icelandic* area Sæmundss mentions in a paper of 1939 (Vid. Medd. Bd. 1 Copenhagen) some species of fish of southe origin new to Iceland and also several spec being more common there during recent years even found in the colder areas of Iceland (no and east). From the Iceland area we shall h repeat that the drift of *cod* and *haddock* to the north coasts of the island was much advanc in July—August 1939, and that the young bott stages of the cod had reached even the east co about one month earlier than previously observ The size of the pelagic stages was greater th normal for the season. The 0-group bottom sta of the *halibut* have been observed previous very rarely in Iceland waters, practically only Faxa Bay during July; they arrive as far as know especially into the coastal waters during autumn. In late July 1939 ($^{29}/_{7}$) we got seve specimens (9) at the same localities where during several years (1924—38), at the same seas and with the same implements, have got but st specimens now and then (a total of 8 specimen and the specimens of 1939 were much larger th previously recorded at the same season (earli 38—51 mm., average 44·0 mm., 1939: 44—70 m average 60·3 mm.). We may ascribe this to strong influx of warmer Atlantic water bringi these stages to the coastal region at an earlier d than usually.

From *Greenland* waters we have no ceptional new records from the year 1939, whi however also had high temperatures in the sea; to 1939, Ad. S. Jensen has however in the pap quoted given much information on the subject.

It has not yet been possible in details to what influence the warm summer, 1939, has h on the growth of adult fish in the areas here co cerned; it will probably be possible duri subsequent years to study this question if adequa material can be collected.

T.

*) cf. also in this connexion my record of a shell of *Spirula* with still adhering parts of tissue from 60°35′ N. Lat. 3°45′ W. Long., Sept. 2nd, 1933 (Rapp. et Proc.-Verb., Vol. LXXXIX, II, p.18).

Faroes.

Fig. 1. Herring Larvae. July 14th to August 23rd 1939.
● Larvae present (July 15th, 17th). × Larvae not present July. + Larvae not present August.

Occurrence of Larval Stages.

On the cruise of the "Dana" to the area only a few pelagic larval stages of the spring-spawning race were caught owing to the late date of the cruise, viz.: two specimens 36—37 mm., one east of Suderø, one south of Myggenæs. The operations were carried out between July 14th and August 23rd; larvae only secured on July 15th and 17th.

This is in accordance with previous investigations, compare T å n i n g: "Young Herring and Sprat in Faroese Waters", Medd. Komm. Danmarks Fiskeri- og Havunders., Ser. Fiskeri, Bd. X, No. 3, 1936, where data have been given for the period 1924—1934.

Larval stages of the summer spawning herring have not been secured.

T.

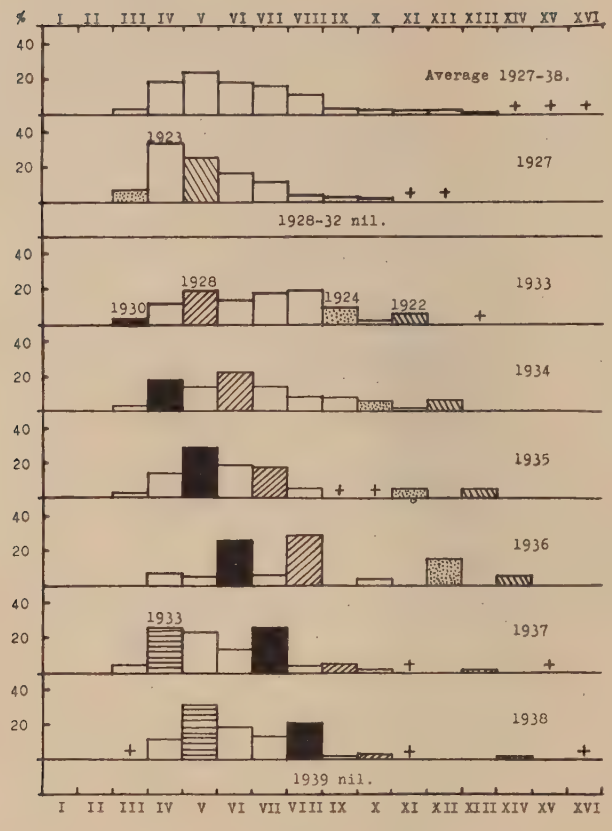

Fig. 2. Spawning Cod, Faroe Islands; Nordhavet. April—May.

Composition of Commercial Catche of Cod from the Native Fishery. Age Composition.

The predominating year-classes in *spring fishery* on spawning cod (No havet) during recent years have been 19 1930, and 1933, as apparent from the anne table and graph. Material from the year 19 has not been available from the spring fish owing *inter alia* to very poor catches. It will seen from the table and the graph that dur some years (1933—1936 especially) the ye classes 1922, and 1924, have been rather g in the Faroes; otolith investigations have sho however, that these year-classes may be c sidered as of northern origin (Iceland or Faroe—Iceland ridge ?, where these two ye classes were predominant during several yea and their presence in Faroe catches indicates t an immigration has tagen place. Ordinarily year-classes of Faroe origin disappear w 9—10 years old.

The *fishery on codling* in Faroese waters the natives and trawlers shows that especially II- and III-groups are caught. Measurements age-determinations show that the year-cla 1930, 1933, 1935, and probably also 1938, h been outstanding during recent years. In stock of cod we find that two "series" of ye classes seem to alternate each with a 5-y period, viz.,

1) 1923 — 1928 — 1933 — 1938? an
2) 1925 — 1930 — 1935.

This is in accordance with the fact Faroe cod mature especially at an age of 5 ye

7

Table 1.

Age Composition of Cod from Spring Fishing Grounds, Nordhavet. (Long-Line Catch

Age-Groups. Percentage-Distribution.

Year	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	Numb analy
1927	—	17	81	62	41	26	7	6	5	1	1	—	—	—	—	24
		6·9	**32·8**	**25·1**	**16·0**	**10·5**	**2·8**	**2·4**	**2·0**	**0·4**	**0·4**	—	—	—	—	—
1933	—	7	33	56	39	53	55	28	6	18	—	1	—	—	—	29
		2·4	**11·2**	**18·9**	**13·2**	**17·9**	**18·6**	**9·5**	**2·0**	**6·1**	—	**0·3**	—	—	—	—
1934	—	7	49	35	59	35	24	22	21	4	16	—	—	—	—	27
		2·6	**18·0**	**12·9**	**21·7**	**12·9**	**8·8**	**8·1**	**7·7**	**1·5**	**5·9**	—	—	—	—	—
1935	—	7	39	79	53	47	14	2	1	15	—	15	—	—	—	27
		2·6	**14·3**	**29·0**	**19·5**	**17·3**	**5·2**	**0·7**	**0·4**	**5·5**	—	**5·5**	—	—	—	—
1936	—	—	6	4	19	5	22	—	3	—	11	—	5	—	—	7
		—	**8·0**	**5·3**	**25·3**	**6·7**	**29·3**	—	**4·0**	—	**14·7**	—	**6·7**	—	—	—
1937	—	6	66	60	32	70	7	10	5	1	—	3	—	1	—	26
		2·3	**25·3**	**23·0**	**12·3**	**26·8**	**2·7**	**3·8**	**1·9**	**0·4**	—	**1·2**	—	**0·4**	—	—
1938	—	2	35	95	59	41	65	5	6	3	—	—	4	—	1	31
		0·6	**11·1**	**30·1**	**18·7**	**13·0**	**20·6**	**1·6**	**1·9**	**0·9**	—	—	**1·3**	—	**0·3**	—
Total	—	46	309	391	302	277	194	73	47	42	28	19	9	1	1	173
%		**2·7**	**17·8**	**22·5**	**17·4**	**15·9**	**11·2**	**4·2**	**2·7**	**2·4**	**1·6**	**1·1**	**0·5**	**0·1**	**0·1**	**100**

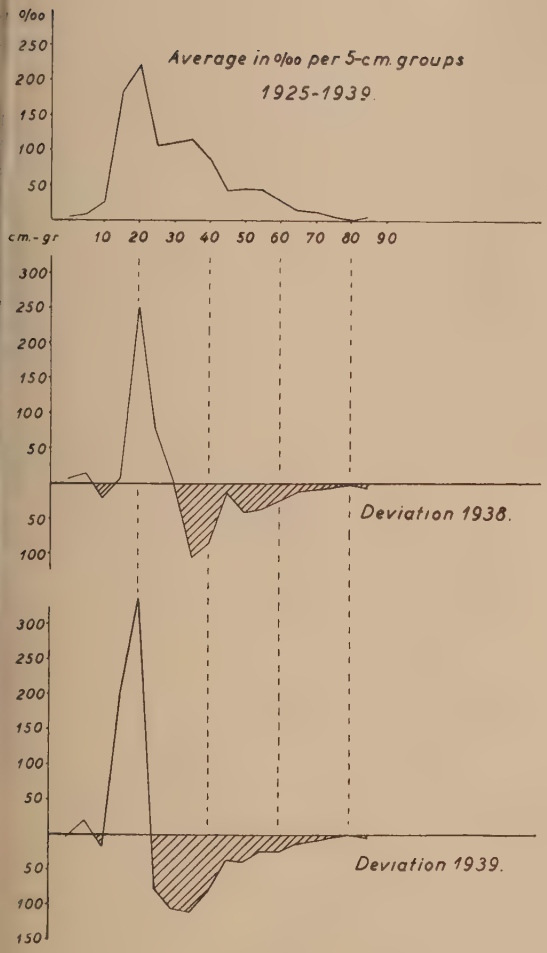

Fig. 3.

Size of Codling from Experimental Trawlings during the Summer Months.

During the summer months especially codling are caught by experimental trawlings, larger cod being scarce on the banks round the Faroes (owing to dispersion). The distribution of sizes in the catches is shown in Fig. 3 for the years 1925—39; all material is from a 50′ otter-trawl, the average catch 1925—39, pr. 10 hours trawling being in April—June 128·2 specimens, in July—August 143·9 specimens.

During recent years all investigations carried out in the area show that the number of *larger cod is decreasing* owing to intense commercial trawling, and the catch consists more and more of small cod only. This is evident *inter alia* from the figure, where the deviation for 1938, and 1939, is given, showing that the experimental trawling in these two years has given a great deficit of larger codling, and an excess of very small cod (I—II-group codling).

T.

Table 2.
Yield of the Spring Cod Fishery in the "Nordhavet".

Long line catch pr. 1000 hooks (Motorboats).

		Percentage by weight
Cod (gutted)	184·3 kg. pr. 1000 hooks	55·9
Haddock (gutted)	133·7 „ „ „ „	40·5
Other fish*)	11·7 „ „ „ „	3·6

*) (Halibut, Tusk, Ling).

The fishery was below normal. (In the period $^{24}/_{2}$ to $^{1}/_{5}$ an average of 2620 hooks per motorboat were used in a total of 224 fishing days; material collected from 8 motorboats of Klaksvig).

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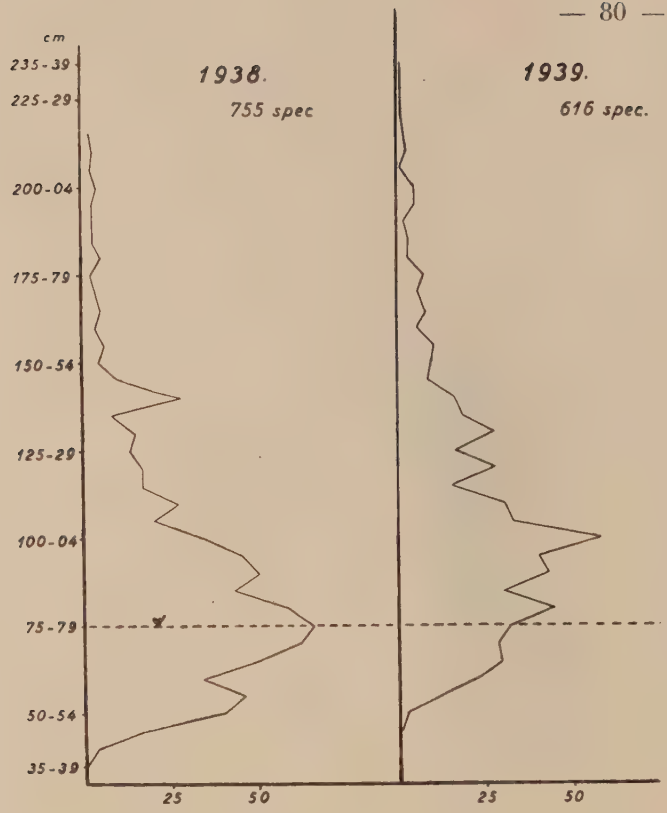


Fig. 4. Size of commercially landed Halibut. Faroes 1938—39.

Measurements of Halibut.

Collections of halibut measurements fro commercial Faroese fishery (long-line catche have been secured during recent years in ord to study alterations in the stock. Of this valuab fish otoliths can rarely be obtained because t fish is nearly always marketed with head. So material, however, has been obtained and w be published by P. J e s p e r s e n in continuati of his paper on the Faroe Halibut Stock Scient. Rep. of the North-Western Area Co mittee (Rapp. et Proc.-Verb., Vol. XCIX, 1936).

Measurements from 1938, and 1939, a given in Fig. 4 (in 5-cm. groups). The catch 1939, is on the whole composed by larger fi than in 1938, owing especially to the growth some younger predominant year-classes.

In 1938, out of 755 specimens measur 42·1 % were below 80 cm.; in 1939, on 20·5 % out of 616 specimens measured we below this limit.

T.

Table 3.
Marking Experiments on 3—5-year-old Halibut.

Experiment July—August 1937: 68 specimens liberated in the fjords.

Year	In the fjords	on the banks	Recaptures at Iceland	in the North Sea	Total
1937	2	1	—	—	3
1938	5	5	4	1	15
1939	—	2	2	1	5
Total	7	8	6	2	23 = **33·8** %

Experiment August 1938: 24 specimens liberated in the fjords.

Year	in the fjords	on the banks	Recaptures at Iceland	in the North Sea	Total
1938	1	—	—	—	1
1939	5	2	1	—	8
1940	1	—	—	—	1
Total	7	2	1	—	10 = **41·7** %

Experiment July—August 1939: 137 spec. liberated in the fjords and on the banks.

Recaptures	in fjords and on the banks	at Iceland	North Sea	Total
1939	9	—	—	9

Concerning emigration of small halibut to other areas, see T å n i n g, Journ. du Conseil, Vol. XIII, 1938, p. 370.

The experiments are not yet finished and more recaptures will certainly be reported. It is, however, worth of notice that the fishery is very intensi on these small halibut of a size about 50—60 cn in the small experiments of 1937, and 1938 33·8 and 41·7 % respectively were recaptured.

T.

Iceland.

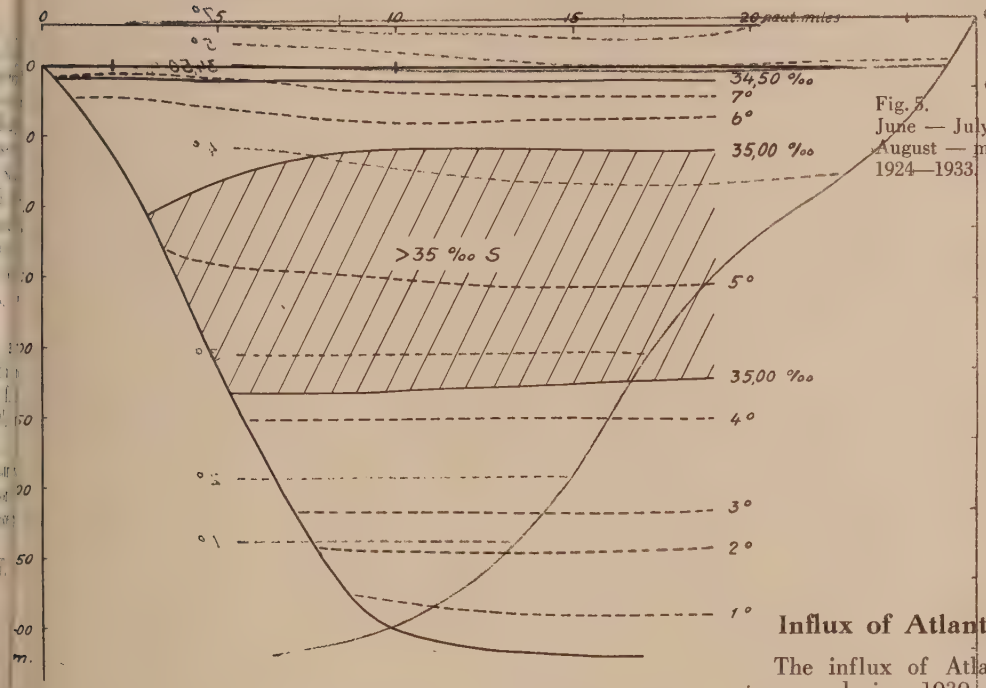


Fig. 5.
June — July — August — mean 1924—1933.

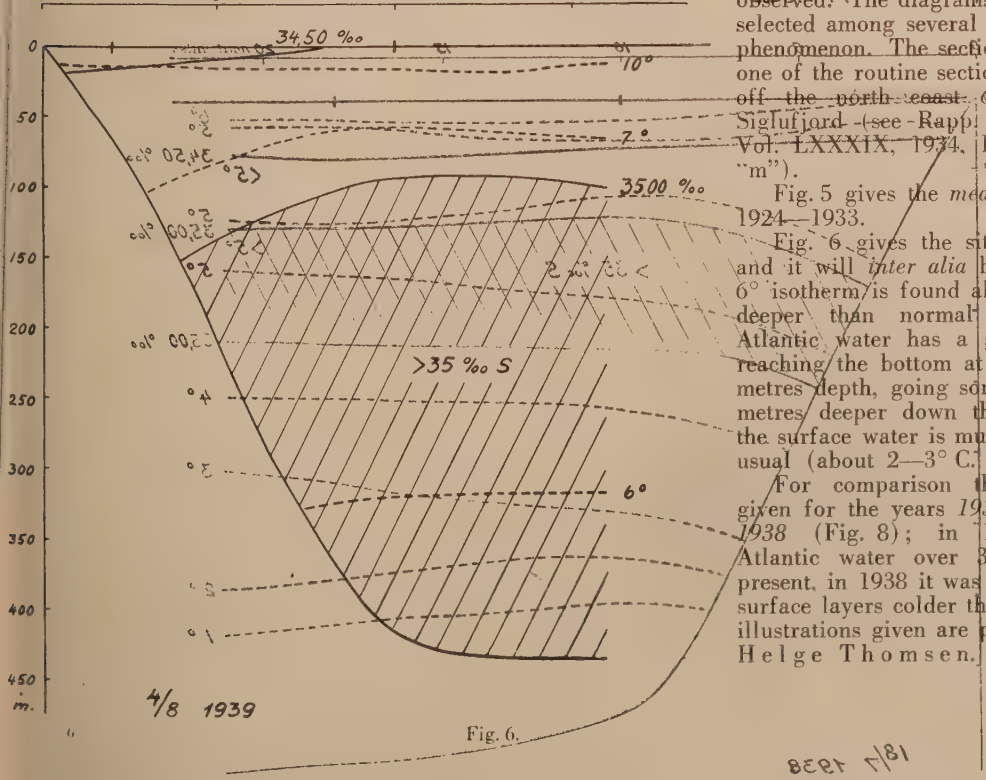


Fig. 6.

Influx of Atlantic Water.

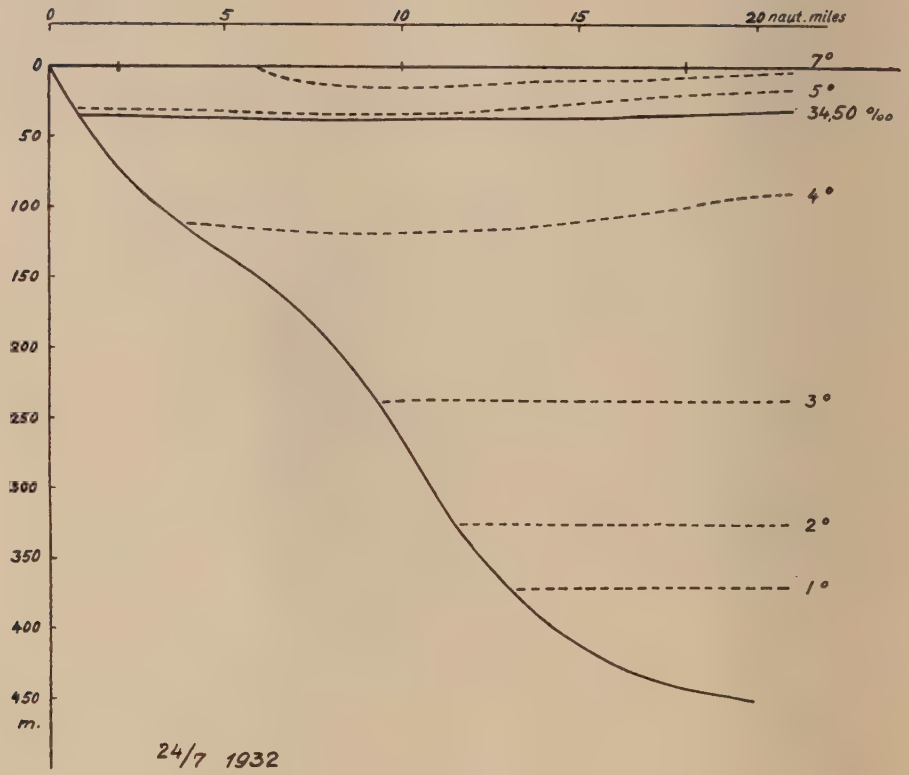
The influx of Atlantic water was stronger during 1939 than previously observed. The diagrams Figs. 5—8 are selected among several to illustrate the phenomenon. The section considered is one of the routine sections and situated off the north coast of Iceland, off Siglufjord (see Rapp. et Proc.-Verb., Vol. LXXXIX, 1934, I, p. 27, section "m").

Fig. 5 gives the *mean* for the years 1924—1933.

Fig. 6 gives the situation in *1939* and it will *inter alia* be seen that the 6° isotherm is found about 275 metres deeper than normal and the salt Atlantic water has a great extension, reaching the bottom at more than 400 metres depth, going some two hundred metres deeper down than usual; also the surface water is much warmer than usual (about 2—3° C. higher).

For comparison the situation is given for the years *1932* (Fig. 7) and *1938* (Fig. 8); in 1932, the salt Atlantic water over 35 ‰ was not present, in 1938 it was present, but the surface layers colder than normal. The illustrations given are prepared by Mr. Helge Thomsen.

T.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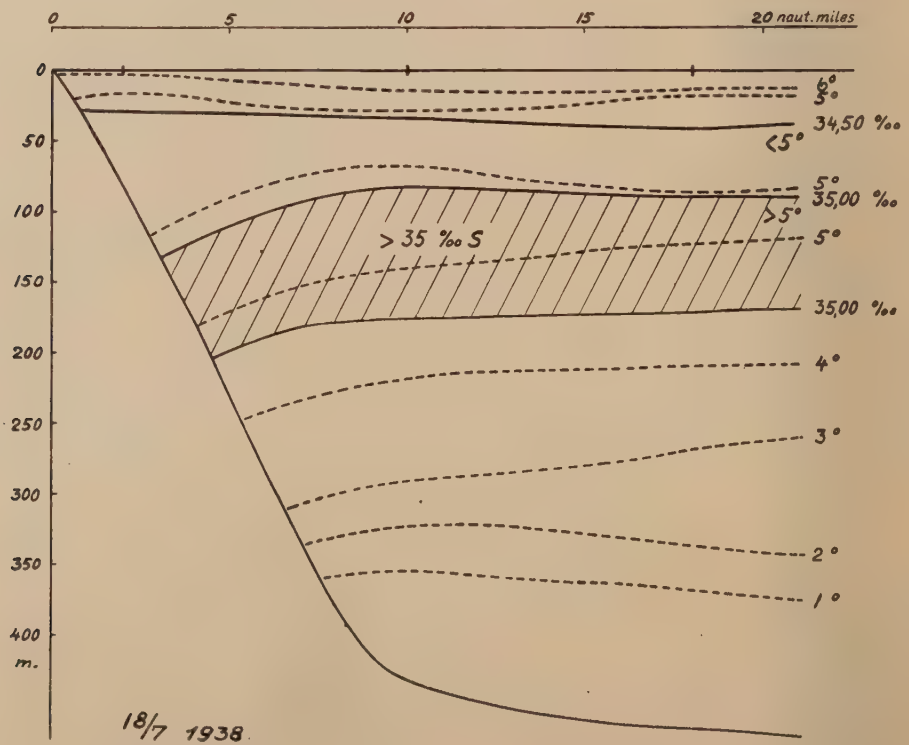
4°
3°
2°
1°
24/7 1932

Fig. 7.


0
5
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15
20 naut. miles
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50
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250
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m.
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34,50 ‰
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2°
1°
18/7 1938

Fig. 8.

The Icelandic Herring Stocks in 1939.

As is well known, two stocks of herring inhabit the Icelandic waters, viz., (1) the *spring-spawning herring* caught off the N.-coast in the summer months and partially also off the S.- and SW.-coast in spring, summer, and autumn, and (2) the *summer-spawning herring* caught off the S.- and SW.- coast in spring, summer and autumn.

As regards the size of the *spring-spawning* herring off the N.-coast a survey is given in Table 4 for the years 1937—1939, based upon nearly 23,000 measurements. Firstly, we see that the standard distribution for these three years shows the greatest frequencies in the size-classes 34—36 cm. (nearly 70 %). Further we are able to get the characteristics of the different years by studying the size-deviations from year to year. In 1937, we had a very good herring year, characterized, as regards the size of the herring, by a considerable surplus in 34 and 35 cm. fish. On the other hand, we find that there is a lack of larger fish, corresponding to a moderate yield in 1936, and to bad yields in 1935, and finally that small-herring frequencies are above normal. We can hardly follow the correlation between the stock and the yields of the fisheries in 1938, and 1939, owing to hydrographical anomalities, affecting the behaviour of the herring on the feeding grounds. Nevertheless, we can follow the plus-deviation from 1937 onwards, and we see that the plus-variants are of a larger size from year to year, being also scattered over a broader range of centimetres. In the year 1937, there appeared a certain number of small herring, and, as will be seen from the table, we can easily follow these plus-variants up to 1939.

Table 5 gives a survey of the age composition of the spring-spawning herring stock from the N.-coast in 1939. Unfortunately we have no age determinations from the preceding years for comparison. We find a slight predominance in the 4-year-old herring but else the material consists of two groups of dominants, viz., 8—10-year herring and -3—15-year-old fish. The percentage distribution according to centimetres and age-groups is given in the table with the average-lengths of the age-groups and the mean age of the whole material.

At the SW.-coast (Table 6) we find quite a different stock of spring-spawning herring than off the N.-coast. Except for 10-year-old herrings the older age-groups are rather scarce here, as the bulk of the material is composed of 3—6-year-old fish, the average age being 6·3 years. Exactly the same is the case as regards the size, as only 14·6 % of the N.-coast stock is less than 34 cm., 11·5 % being larger than 36 cm., while the corresponding figures for the stock from the SW.-coast are 51·6 and 5·2 cm. In this connexion it is worth mentioning that the SW.-coast catches quantitatively make out only about 1 % of the N.-coast catches and that only about 25 % of the SW.-coast catches are spring-spawning herring the remainder being young immature fish, predominantly summer-spawning herring.

Finally, Table 7 gives a survey of the summer-spawning stock of herring in the fishery of the SW.-coast. The stock was, in 1939, mainly composed of 4—6-year-old fish, and, as will be seen from the table, the mean age was only 5·6 years. The size-distribution differs greatly from that of the N.-coast herring, as here we have to deal with much smaller fish, and, when compared with the size-distribution of the spring-spawning herring from the SW.-coast, there are also certain differences, the summer-spawning herring varying more equally in size.

Árni Friðriksson.

Table 4.

Size and Size-Deviations in the Herring Stock of the North Coast of Iceland (June—Sept.) in the years 1937—1939.

	Size-Distributions ‰ Cm.				Deviations ‰		
Cm.	1937	1938	1939	Stand.	1937	1938	1939
40	—	—	0·4	0·1	0·1	0·1	**0·3**
39	2·0	4·5	4·2	3·6	1·6	**0·9**	**0·6**
38	15·1	14·2	24·0	17·8	2·7	3·6	**6·2**
37	76·0	91·4	104·3	90·6	14·6	**0·8**	**13·7**
36	217·4	263·4	257·1	246·0	28·6	**17·4**	**11·1**
35	366·5	338·6	304·5	336·4	**30·1**	**2·2**	31·9
34	232·1	209·8	178·0	206·7	**25·4**	**3·1**	28·7
33	72·8	55·2	77·4	68·5	**4·3**	13·3	**8·9**
32	10·4	12·5	33·4	18·8	8·4	6·3	**14·6**
31	4·4	5·6	10·9	7·0	2·6	1·4	**3·9**
30	1·3	3·0	4·4	2·9	1·6	**0·1**	**1·5**
29	0·1	1·0	1·4	0·8	0·7	**0·2**	**0·6**
28	0·1	0·2	—	0·1	0·0	**0·1**	0·1
27	0·2	0·4	—	0·2	0·0	**0·2**	0·2
26	0·3	0·2	—	0·2	**0·1**	0·0	0·2
25	0·1	—	—	+	**0·1**	–	–
24	0·3	—	—	0·1	**0·2**	0·1	0·1
23	0·4	—	—	0·1	**0·3**	0·1	0·1
22	0·4	—	—	0·1	**0·3**	0·1	0·1
21	0·0	—	—	—	0·0	0·0	0·0
20	0·1	—	—	—	**0·1**	–	–
Tot.	1000·0	1000·0	1000·0	1000·0	0·0	0·0	0·0
No.	10369	5238	7231	22838	60·9	25·0	61·4
Cm.	34·57	35·12	35·06	—	—	—	—

Minus variations (ordinary type) and plus-variations (heavy type).

Table 5.

Age Composition of the Spring-Spawning Stock of Herring.

(June—Sept.) in the years 1937–1939.

Cm.	1937			1938			1939		
	Stock.	Catch.	Stand.	Stock.	Catch.	Stand.	Stock.	Catch.	Stand.
20	—	—	—	—	—	—	2·0	1·5	0·1
21	—	—	—	—	—	—	15·1	11·3	0·6
22	—	—	—	—	—	—	27·1	21·3	1·5
23	—	—	—	—	—	—	44·0	34·4	2·4
24	—	—	—	—	—	—	60·0	47·1	3·3
25	—	—	—	—	—	—	73·4	57·6	4·0
26	—	—	—	—	—	—	82·1	64·5	4·5
27	—	—	—	—	—	—	87·6	68·8	4·8
28	—	—	—	—	—	—	89·8	70·5	4·9
29	—	—	—	—	—	—	89·0	69·9	4·9
30	—	—	—	—	—	—	85·5	67·1	4·7
31	—	—	—	—	—	—	80·0	62·8	4·4
32	—	—	—	—	—	—	73·0	57·3	4·0
33	—	—	—	—	—	—	65·0	51·0	3·6
34	—	—	—	—	—	—	56·4	44·3	3·1
35	—	—	—	—	—	—	47·6	37·4	2·6
36	—	—	—	—	—	—	39·0	30·6	2·1
37	—	—	—	—	—	—	30·8	24·2	1·7
38	—	—	—	—	—	—	23·8	18·7	1·3
39	—	—	—	—	—	—	17·8	14·0	1·0
40	—	—	—	—	—	—	13·0	10·2	0·7
41	—	—	—	—	—	—	9·4	7·4	0·5
42	—	—	—	—	—	—	6·6	5·2	0·4
43	—	—	—	—	—	—	4·5	3·5	0·3
44	—	—	—	—	—	—	3·0	2·4	0·2
45	—	—	—	—	—	—	2·0	1·6	0·1
46	—	—	—	—	—	—	1·3	1·0	0·1
47	—	—	—	—	—	—	0·8	0·6	0·1
48	—	—	—	—	—	—	0·5	0·4	0·0
49	—	—	—	—	—	—	0·3	0·2	0·0
50	—	—	—	—	—	—	0·2	0·2	0·0
51	—	—	—	—	—	—	0·1	0·1	0·0
52	—	—	—	—	—	—	0·1	0·1	0·0
53	—	—	—	—	—	—	0·0	0·0	0·0
54	—	—	—	—	—	—	0·0	0·0	0·0
55	—	—	—	—	—	—	0·0	0·0	0·0
Total	—	—	—	—	—	—	1000·0	800·0	56·6
%	—	—	—	—	—	—	100·0	80·0	5·6
Cm.	—	—	—	—	—	—	35·57	35·12	35·06
Av. Age	—	—	—	—	—	—	10·29	9·98	9·98
Num.	—	—	—	—	—	—	10290	8232	7231
Wt.	—	—	—	—	—	—	10290	6586	4339

Average age = 11·6 years.

Fig. 9. Iceland. Size of Herring. Deviations from the Mean. (cf. Table 4).

Table 6.

Age Composition of the Spring-Spawning Stock of Herring

(Maturity-Stage IV—V in Oct.—Nov.) off the SW. Coast of Iceland in the Year 1939. Drift-nets.

Brood from / Age (Years)	1936 3	1935 4	1934 5	1933 6	1932 7	1931 8	1930 9	1929 10	1928 11	1927 12	1926 13	1925 14	Tot.	%
cm. 38	—	—	—	—	—	—	—	—	—	1	—	—	1	1·1
37	—	—	—	—	—	—	—	1	2	1	—	—	4	4·1
36	—	—	—	—	—	2	2	6	3	—	1	—	14	14·4
35	—	—	—	1	2	3	2	3	1	—	—	—	12	12·3
34	—	1	1	7	3	2	—	2	—	—	—	—	16	16·5
33	—	4	3	2	—	—	—	—	—	—	—	—	9	9·3
32	—	15	5	—	—	—	—	—	—	—	—	—	20	20·7
31	5	9	1	—	—	—	—	—	—	—	—	—	15	15·4
30	4	2	—	—	—	—	—	—	—	—	—	—	6	6·2
Total	9	31	10	10	5	7	4	12	6	2	1	—	97	100·0
%	9·3	32·0	10·3	10·3	5·1	7·2	4·1	12·4	6·2	2·1	1·0	—	—	100·0
cm.	30·6	31·8	32·4	33·9	34·4	35·0	35·5	35·5	36·2	37·5	36·0	—	—	—

Average-age = 6·3 years.

Table 7.

Age Composition of the Summer-Spawning Stock of Herring

(Maturity-Stage II(VIII?)—III in Oct.—Nov.) off the SW. Coast of Iceland in the Year 1939. Drift-nets.

Brood from / Age (Years)	1936 3	1935 4	1934 5	1933 6	1932 7	1931 8	1930 9	1929 10	1928 11	1927 12	1926 13	1925 14	1924 15	Total	%
cm. 37	—	—	—	—	—	—	1	1	3	1	—	—	—	6	2·0
36	—	—	—	—	2	4	3	4	3	1	—	—	1	18	5·9
35	—	—	—	17	7	12	4	2	—	—	—	—	—	42	13·9
34	—	1	11	26	9	3	2	—	—	—	—	—	—	54	17·8
33	1	15	25	13	2	1	1	—	—	—	—	—	—	58	19·1
32	1	60	20	3	—	—	—	—	—	—	—	—	—	84	27·7
31	6	18	4	—	—	—	—	—	—	—	—	—	—	28	9·3
30	11	—	—	—	—	—	—	—	—	—	—	—	—	11	3·6
29	2	—	—	—	—	—	—	—	—	—	—	—	—	2	0·7
Total:	21	94	60	59	20	22	11	7	6	2	—	—	1	303	100·0
%	6·9	31·0	19·8	19·5	6·6	7·3	3·6	2·3	2·0	0·7	—	—	0·3	100·0	
Cm. e. a.	30·4	33·0	32·7	34·0	34·4	34·9	35·1	35·9	36·5	36·5	36·0	—	—	—	

Average-age = 5—6 years.

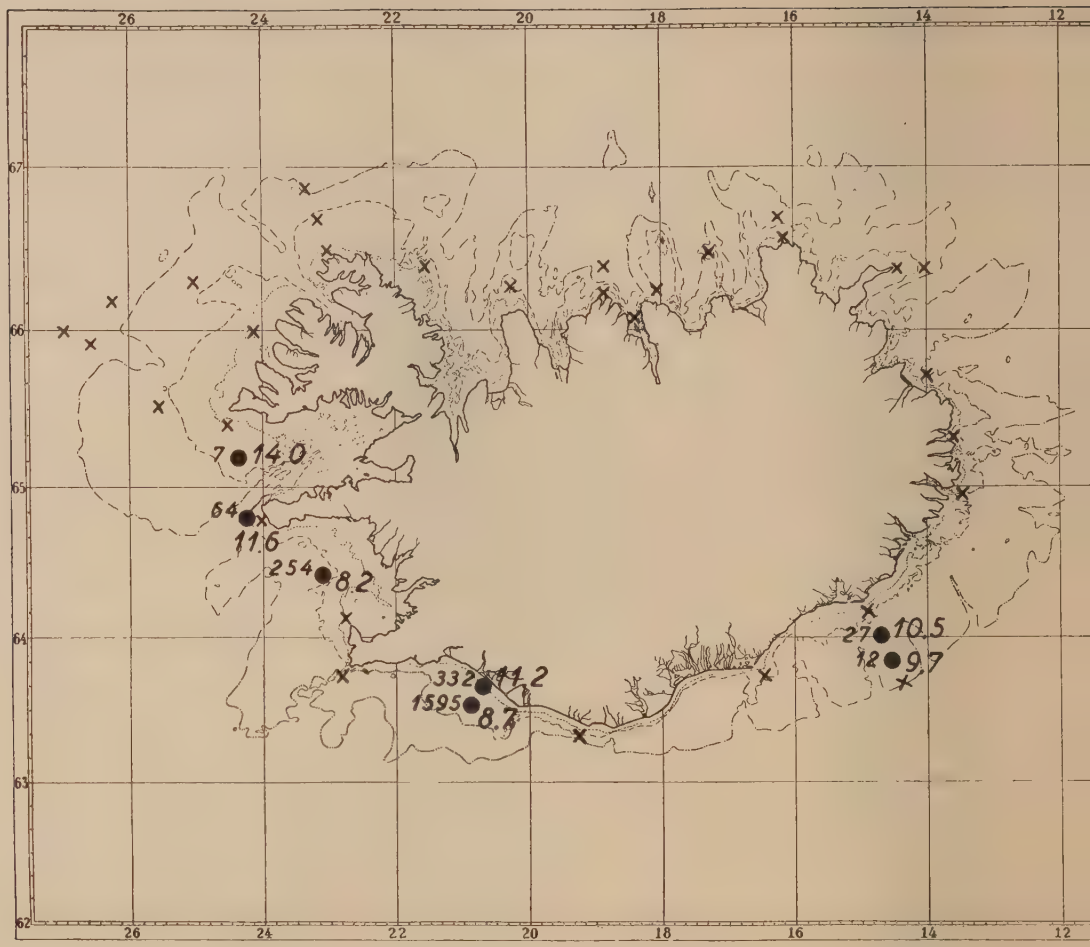


Fig. 10. Herring. Larval Stages. July—August 1939.
● larvae present. *Total catch* and *average size* of larvæ indicated.
× „ not present.

Occurrence of Larval Stages. Summer 1939.

During the cruise of the "Dana" round Iceland in July—August, larval stages of the summer-spawning herring were met with especially at the Selvogsbanki, south Iceland. The maximum catch per 30 min. oblique haul (2 m. stramin net) was about 1600 specimens. Few were met with at south-east Iceland where some previous years have given rich hauls. The average size of larvae from the richer stations indicates that spawning has taken place at some distance from land (off the south-west and west coasts). See the annexed chart, Fig. 10.

In a survey in Rapp. et Proc.-Verb., Vol. X 1936, VI, all data from the years 1924—34 summarized (no investigations have been ca out with respect to this species during the 1935—37 at the season, when these stages present); in the cold year, 1938, investigations not made off south Iceland, and on the west only a few hauls were made in which a single (16 mm.) was taken off Látrabjarg on 17. and another off Cape North on the same (29 mm. long); both were certainly of the sp spawning race.

The size distribution of the pelagic stages caught in 1939 was as follows:

Table 8.

cm.	South-East 19/7 St. 6109	South-East 19/7 St. 6110	South 21/7 St. 6117	South 21/7 St. 6118	West 29—30/7 St. 6178	West 29—30/7 St. 6184	West 29—30/7 St. 6185
0	—	—	—	—	1	—	—
9	—	—	—	—	1	—	—
8	—	—	—	2	—	1	—
7	—	—	4	2	1	—	—
6	—	—	12	4	3	—	3
5	—	—	13	12	3	2	1
4	—	—	15	12	—	1	—
3	—	—	17	6	1	8	—
2	—	3	39	13	1	19	2
1	1	10	95	64	—	20	1
10	7	12	87	232	11	11	—
9	3	2	44	486	37	2	—
8	1	—	5	378	95	—	—
7	—	—	1	313	65	—	—
6	—	—	—	45	20	—	—
Total	12	27	332	1569	239	64	7
Average size	a_{12} = 9·67	a_{27} = 10·52	a_{332} = 11·18	a_{1569}*) = 8·67	a_{239}**) = 8·17	a_{64} = 11·59	a_{7} = 14·0

*) Moreover 26 damaged specimens.
**) Moreover 15 damaged specimens.

T.

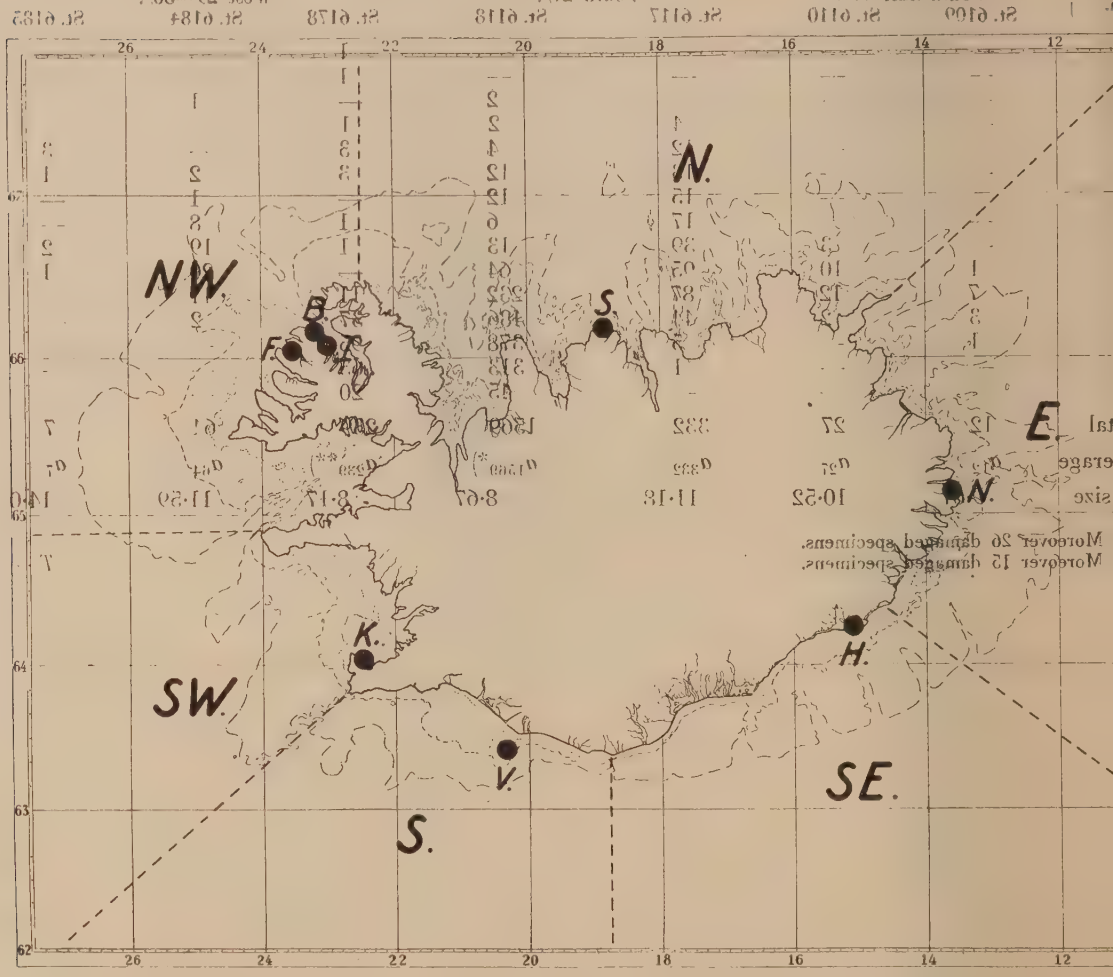


Fig. 11. Chart, showing the Places, where Material for Cod-Investigations has been collected.

B = Bolungavík. F = Flateyri. H = Hornafjörður. I = Isafjörður.
K = Keflavík. N = Nordfjörður. S = Siglufjörður. V = Westm. Isl.

The Icelandic Cod-Stock in 1939.

In the two following tables we are going to compare the size (Table 9) and the age (Table 10) of the cod in the year 1939 with those of the previous years. All the material originates from fish caught by *long-line* in the commercial fish at 6 fishing places, viz., Hornafjörður (SE.-co See the chart Fig. 11), Westman Islands (S.-coa Keflavík (SW.-coast, Faxa Bay), Isafjörður,

gavík and Flateyri (NW.-coast), Siglufjörður f.-coast) and Norðfjörður (E. coast). The ma- eal, upon which the tables are based, has been ected, as follows:

Year of Collection:	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939
Hornafj.										+	+	+
Westm.										+	+	+
Keflavík										+	+	+
Isaf.	+	+	+	—	—	—	—	—	—	—	—	—
Hungavík								+[1]		—	—	—
Flateyri										—	+	+
Siglufj.								+[1]		—	+	+
Nordfj.										+	+	+

[1] Otoliths were not collected.

The Tables 9 and 10 show (1) the standard (mean) distribution (St.) of the cod according to e (Table 9) and age (Table 10), (2) the distri- tion in the year 1939 (1939) and (3) the de- viations in the year 1939 from the standard for each cm. group and each age-class. At the foot of he columns the number is recorded of fish treated all (St.) and in the year 1939 specially and nally the total variation (plus or minus) from e standard.

1. Size (Table 9 and Fig. 12). At all the places ferred to in the table we find a considerable plus- ariation in the small size-groups, except for the estman Islands. This is especially the case off he N.- and E.-coasts where the superfluous number f small fish is very clear, indicating a relative trength of one or more young year-classes. On he other hand medium sized fish are almost every- where lacking, whereas we find a surplus in the argest classes in the warm-water area.

2. Age (Table 10 and Fig. 13). In good agree- ment with the size-distribution, we find a surplus of young or rather young fish at all the places where collections have taken place. Thus, 5-year- old fish (the brood from 1934) is very numerous n Hornafjord, 3 and 9-year-old fish in the Westman islands, 5 and especially 8-year-old fish in Keflavík, 4-year-old fish off the NW.-coast, 3 and 4-year-old fish off the N.-coast and 4 and 5-year-old fish off the E.-coast. Thus the 8—9-year-old fish (originat- ing from 1931 and 1930) have made up more than half the stock on the principal spawning grounds, and, as they do not appear in the fishery off the colder parts of the coast later in the year (N.- and E. coast), in any considerable number, we must suppose that they have migrated to other cold-water regions (Greenland?) after spawning. The 5-year-old fish are more widely distributed than any other of the younger year-classes, except on the spawning grounds, but in addition the 4-year-old and even 3-year-old fish seem to be rather predominating. In all places we find a pronounced lack of 10—14-year-old fish (compare however the 1936-brood), viz., the year-classes 1925—1929, whereas older fish (especially 15 and 17 years old) predominate on the central spawning grounds. These year-classes (viz. 1922 and 1924) gave a very good yield in the years 1930—1935 when they were in their optimal age (8—11 years) and now we find them in surplus as very old, but on account of their great scarceness they are rather unimportant in the fishery.

The lack of really good year-classes from the years 1925—1929 caused a bad codfishery in 1936—1937, but thanks to the broods of 1930—1931 the yields have been somewhat better in 1938—1939. The brood from 1931 seems for the greatest part to have grown up in Greenland waters*), as we have not found it as immature in colder waters during the preceding years in any considerable number. Therefore, one might assume, that only a part of this year-class has reached ripeness, and the continuing recruitment to the spawning grounds must follow in the nearest future. In 1942 we may further expect the first contingent of the brood from 1934 (5-year-old fish in 1939) to the spawnings grounds.

Árni Friðriksson.

*) cf. the notes on marked Greenland cod, pp. 107 and 114, of which many belonging to the 1931-brood have been recaptured as immigrants to Iceland waters during 1939 *(T.)*.

Table 9.

Cod. — Iceland — 1939. Size-Deviations.

Cm.	SE. (Hornafj.) St.[1]	1939	Dev.	S. (Vestmanna Isl.) St.	1939	Dev.	SW. (Keflavík) St.	1939	Dev.	NW.[2] St.	1939	Dev.	N. (Siglufj.) St.	1939	Dev.	E. (Nordfj.) St.	1939	Dev.
150—154	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
145—149	—	—	—	—	0·3	**0·3**	—	—	—	—	—	—	—	—	—	0·1	0·6	**0·5**
140—144	—	—	—	—	—	—	—	0·2	**0·2**	—	—	—	—	—	—	0·2	—	0·2
135—139	—	0·3	**0·3**	0·1	0·3	**0·2**	0·1	0·3	**0·2**	0·1	0·4	**0·3**	—	—	—	0·3	—	0·3
130—134	0·6	0·6	**0·0**	0·5	1·5	**1·0**	0·3	0·6	**0·3**	0·2	—	0·2	—	—	—	0·4	0·3	0·1
125—129	2·0	5·2	**3·2**	0·5	1·7	**1·2**	0·4	0·8	**0·4**	0·4	—	0·4	0·2	—	0·2	2·5	6·0	**3·5**
120—124	9·7	25·0	**15·3**	1·5	3·8	**2·3**	0·8	1·2	**0·4**	1·0	—	1·0	1·8	3·0	**1·2**	6·6	10·8	**4·2**
115—119	34·1	57·4	**23·3**	5·1	12·2	**7·1**	2·1	2·8	**0·7**	2·5	1·7	0·8	4·9	—	4·9	19·0	21·3	**2·3**
110—114	80·3	74·8	5·5	13·8	32·2	**18·4**	4·8	6·5	**1·7**	5·8	0·4	5·4	5·5	—	5·5	36·5	31·8	4·7
105—109	91·5	61·8	29·7	30·6	72·3	**41·7**	14·1	16·2	**2·1**	9·9	2·1	7·8	10·5	—	10·5	46·6	32·4	14·2
100—104	107·3	32·4	74·9	65·8	164·2	**98·4**	36·4	46·5	**10·1**	17·1	5·9	11·2	14·8	—	14·8	51·1	27·7	23·4
95—99	113·0	33·5	79·5	125·3	242·6	**117·3**	82·9	80·3	2·6	30·0	5·9	24·1	27·6	3·0	24·6	60·8	24·8	36·0
90—94	115·8	55·0	60·8	173·2	216·4	**43·2**	142·6	122·5	20·1	49·6	24·2	25·4	53·0	6·0	47·0	71·0	20·7	50·3
85—89	106·2	65·7	40·5	210·4	137·7	72·7	196·4	154·3	42·1	78·6	37·6	41·0	96·0	14·0	82·0	79·1	20·0	59·1
80—84	96·0	70·1	25·9	186·8	72·9	113·9	206·3	184·7	21·6	107·4	68·1	39·3	135·7	9·0	126·7	78·3	34·3	44·0
75—79	63·8	84·4	**20·6**	117·0	27·6	89·4	152·3	150·3	2·0	127·3	71·4	55·9	142·9	25·0	117·9	80·1	56·0	24·1
70—74	57·4	135·8	**78·4**	49·0	10·8	38·2	83·9	92·3	**8·4**	133·8	81·0	52·8	102·2	42·0	60·2	80·1	73·8	6·3
65—69	47·5	127·3	**79·8**	14·0	2·6	11·4	35·6	46·4	**10·8**	104·7	101·5	3·2	68·3	42·0	26·3	88·2	98·0	**9·8**
60—64	34·2	91·3	**57·1**	3·9	0·6	3·3	16·5	32·3	**15·8**	88·8	139·1	**50·3**	55·4	50·0	5·4	87·0	109·3	**22·3**
55—59	22·4	48·4	**26·0**	2·0	0·3	1·7	14·4	33·2	**18·8**	75·0	164·2	**89·2**	59·0	64·0	**5·0**	82·0	178·3	**96·3**
50—54	12·5	21·7	**9·2**	0·5	—	0·5	8·0	21·8	**13·8**	62·1	139·9	**77·8**	75·8	165·0	**89·2**	63·5	174·3	**110·8**
45—49	3·7	8·5	**4·8**	—	—	—	1·7	5·7	**4·0**	46·1	85·6	**39·5**	69·4	206·0	**136·6**	45·1	67·9	**22·8**
40—44	1·7	0·5	1·2	—	—	—	0·3	1·1	**0·8**	40·3	61·4	**21·1**	51·2	226·0	**174·8**	17·4	9·2	8·2
35—39	0·3	0·3	**0·0**	—	—	—	0·1	—	0·1	14·9	8·8	6·1	23·9	136·0	**112·1**	3·7	2·5	1·2
30—34	—	—	—	—	—	—	—	—	—	4·3	0·8	3·5	1·8	9·0	**7·2**	0·4	—	0·4
25—29	—	—	—	—	—	—	—	—	—	0·2	—	0·2	0·1	—	0·1	1000·0	1000·0	0·0
Total:	1000·0	1000·0	0·0	1000·0	1000·0	0·0	1000·0	1000·0	0·0	1000·1	1000·0	0·1	1000·0	1000·0	0·0	40421	3149	272·5
Number	15025	3638	318·0	27264	3442	331·1	39007	6473	88·5	24711	2394	278·3	34415	358	526·1			

In the "deviation"-column figures in heavy type mean plus-variations, in ordinary type, minus-variations.

[1]) St. = Mean 1928—1939.
[2]) Flateyri, Bolungavík and Isafjörður.

Table 10.

Age and Age-Deviations in the Icelandic Cod Stock in 1939.

Age	Brood	SE. (Hornafjörður) St.[1]	SE. (Hornafjörður) 1939	SE. (Hornafjörður) Dev.	S. (Vestmannaeyjar) St.	S. (Vestmannaeyjar) 1931	S. (Vestmannaeyjar) Dev.	SW. (Keflavík.) St.	SW. (Keflavík.) 1939	SW. (Keflavík.) Dev.	NW.[2] St.	NW.[2] 1939	NW.[2] Dev.	N. (Sigl.) St.	N. (Sigl.) 1939	N. (Sigl.) Dev.	E. (Nordfjörður) St.	E. (Nordfjörður) 1939	E. (Nordfjörður) Dev.
2	1937	—	—	—	—	—	—	—	—	—	15·4	61·0	**45·6**	—	—	—	0·3	—	0·3
3	36	5·8	2·0	3·8	—	—	—	1·6	—	1·6	86·6	161·0	**74·4**	56·2	200·0	**143·8**	19·0	—	19·0
4	1935	35·7	105·0	**69·3**	0·5	0·0	0·5	15·4	44·0	**28·6**	116·0	260·0	**144·0**	158·6	670·0	**511·4**	110·1	348·0	**237·9**
5	34	73·5	430·0	**356·5**	5·2	10·0	**4·8**	22·0	63·0	**41·0**	100·6	146·0	**45·4**	122·8	90·0	32·8	180·5	445·0	**264·5**
6	33	64·4	142·0	**77·6**	20·0	33·0	**13·0**	23·1	36·0	**12·9**	129·2	63·0	66·2	109·3	10·0	99·3	178·7	102·0	76·7
7	32	61·2	25·0	36·2	47·8	77·0	**29·2**	71·9	93·0	**21·1**	129·9	65·0	64·9	74·9	—	74·9	78·5	40·0	38·5
8	31	73·1	82·0	**8·9**	158·7	253·0	**94·3**	142·3	340·0	**197·7**	148·5	140·0	8·5	149·4	10·0	139·4	117·4	30·0	87·4
9	1930	96·6	25·0	71·6	182·3	269·0	**86·7**	205·0	154·0	51·0	122·4	29·0	93·4	107·9	10·0	97·9	75·9	20·0	55·9
10	29	136·1	5·0	131·1	166·0	57·0	109·0	184·1	68·0	116·1	71·9	26·0	45·9	130·6	—	130·6	48·2	—	48·2
11	28	66·3	5·0	61·3	143·6	37·0	106·6	144·2	21·0	123·2	45·3	19·0	26·3	37·5	—	37·5	45·8	—	45·8
12	27	80·8	0·0	80·8	97·6	29·0	68·6	92·5	47·0	45·5	12·9	4·0	8·9	26·8	—	26·8	32·5	10·0	22·5
13	26	67·0	25·0	42·0	67·5	73·0	**5·5**	46·0	32·0	14·0	9·9	16·0	**6·1**	5·3	—	5·3	35·4	—	35·4
14	1925	45·6	2·0	43·6	40·7	29·0	11·7	24·0	15·0	9·0	2·0	—	2·0	7·0	—	7·0	20·1	—	20·1
15	24	58·0	57·0	1·0	37·7	70·0	**32·3**	14·7	57·0	**42·3**	4·4	10·0	**5·6**	5·3	10·0	**4·7**	17·6	—	17·6
16+	1923—	132·6	82·0	50·6	31·7	56·0	**24·3**	12·8	30·0	**17·2**	5·0	—	5·0	8·4	—	8·4	39·5	5·0	34·5
?	?	3·3	13·0	**9·7**	0·7	7·0	**6·3**	0·4	—	0·4	—	—	—	—	—	—	0·5	—	0·5
Total:		1000·0	1000·0	0·0	1000·0	1000·0	0·0	1000·0	1000·0	0·0	1000·0	1000·0	0·0	1000·0	1000·0	0·0	1000·0	1000·0	0·0
Number		2079	402	522·0	4358	301	296·4	4631	473	360·8	3009	300	321·1	3596	100	659·9	4417	198	502·4

In the "deviation"-column figures in heavy type mean plus-variations, in ordinary type, minus-variations.

[1] Mean 1928—1939.
[2] Flateyri, Bolungavík and Isafjörður.

Iceland. Cod

Table 10. Deviations in the Icelandic Cod Stock in 1939.

Fig. 12. Iceland. Size of Cod.
Deviation 1939 from the mean 1928—39.

Fig. 13. Iceland. Age Distribution of Cod.
Deviation 1939 from the mean 1928—39.

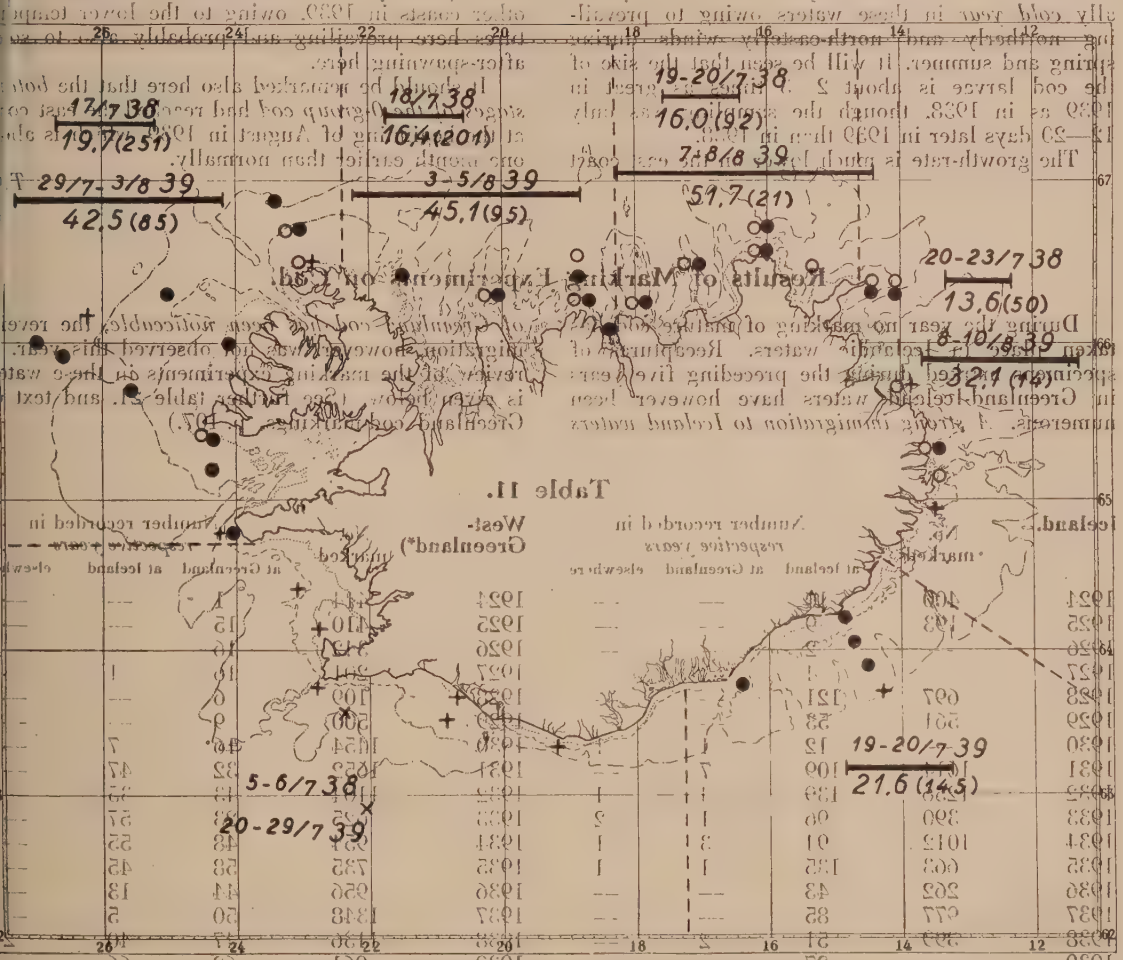


Fig. 14. Distribution and Size of Cod Fry 1938 and 1939.

For each area date and year, average size in mm. and number of specimens (in brackets) are given.

1938 1939
Total ●812-10 Larvae present
not present

Drift and Growth of Cod Larvae.

The dispersion of cod larvae from the spawning places off the south-west and west coasts of Iceland to the north and east coasts is of paramount importance to the fishery in subsequent years on the latter coasts.

The influence of the very extensive influx of warm Atlantic water to the area north of Iceland in 1939 is, accordingly, of great importance to the dispersion of cod as well as of other fish larvae in the area. The hydrographical sections (Figs. 5—8) show that the year 1939 in this respect is unique, probably among all years of this century.

The cod larvae have followed the strong east-going branch of the Irminger current north of Iceland and have moreover owing to the favourable conditions in the sea reached a *larger size than normal* of the season. The chart (Fig. 14) shows this; we have here combined the results of 1939

with those of 1938, which year was an exceptionally *cold year* in these waters owing to prevailing northerly and north-easterly winds during spring and summer. It will be seen that the size of the cod larvae is about 2—3 times as great in 1939 as in 1938, though the sampling was only 12—20 days later in 1939 than in 1938.

The growth-rate is much lower on the east coast and especially on the south-east coast than off other coasts in 1939, owing to the lower temp tures here prevailing and probably also to s after-spawning here.

It should be remarked also here that the *bot stages of the 0-group cod* had reached the east c at the beginning of August in 1939, which is al one month earlier than normally.

Results of Marking Experiments on Cod.

During the year no marking of mature cod has taken place in Icelandic waters. Recaptures of specimens marked during the preceding five years in Greenland-Iceland waters have however been numerous. *A strong immigration to Iceland waters of Greenland cod has been noticeable,* the rev migration, however, was not observed this year review of the marking experiments in these wa is given below. (See further table 21, and text Greenland cod-markings, p. 107.)

Table 11.

Iceland.	No. marked	Number recorded in *respective years* at Iceland	at Greenland	elsewhere
1924	400	10	—	—
1925	193	9	—	—
1926	—	2	—	—
1927	—	4	—	—
1928	697	121	—	—
1929	561	53	—	—
1930	—	12	1	1
1931	1614	109	7	—
1932	1256	139	4	1
1933	390	96	1	2
1934	1012	94	3	1
1935	663	135	1	1
1936	262	43	—	—
1937	977	85	—	—
1938	399	51	2	—
1939	—	27	—	—
Total	8424	990	19	6
		1015 = 12·0 %.		

West-Greenland*)	No. marked	Number recorded in *respective years* at Greenland	at Iceland	elsew
1924	414	1	—	–
1925	410	15	—	–
1926	342	16	—	–
1927	201	16	1	–
1928	109	6	—	–
1929	500	9	—	–
1930	1454	16	7	–
1931	1652	32	47	–
1932	1104	43	35	–
1933	625	23	57	–
1934	954	48	55	–
1935	735	58	45	–
1936	956	44	13	–
1937	1348	50	5	–
1938	1136	47	40	
1939	861	62	66	–
1940	0	1	—	–
Total	12801	487**)	371	
		862 = 6·7 %.		

*) In East Greenland waters 772 cod have been liberated during the years 1926—33; 19 were recaught, of which 17 at Iceland.

**) Moreover 2 of which the year of recapture has been recorded.

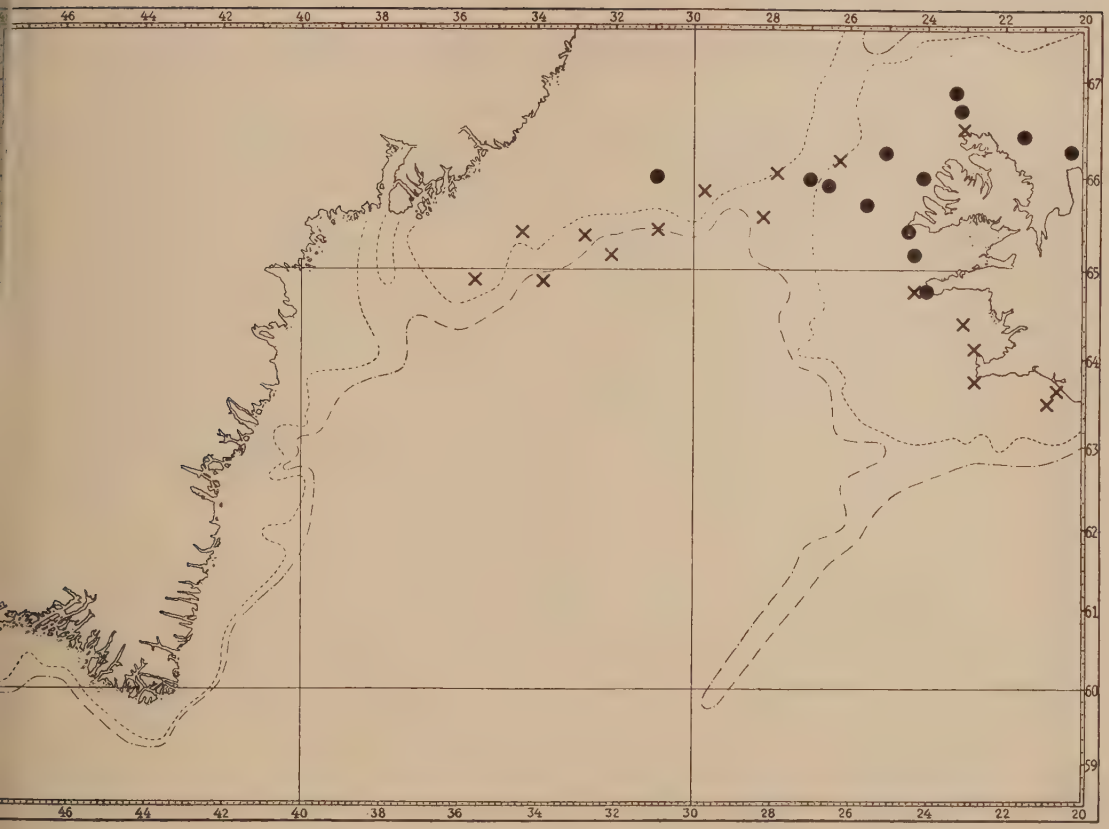


Fig. 15. Drift of Cod Larvæ. 21. July — 4. Aug. 1939.

Cod. Drift of Larval Stages across the Denmark Strait, 1939.

About August 1st (July 30th to August 3rd) "Dana" crossed the Denmark Strait, to about W., at the height of Angmagssalik (see chart . 15). Cod fry was present in fair numbers r the banks close to north-west Iceland, but one y was taken in the strait proper (ca. 66° N. 55′ W.). High temperatures were prevailing in strait as off west and north Iceland (compare rographical notes p. 81); no ice present.

When comparing these results with the results given on the chart (Fig. 16) summarizing previous investigations during July—August, 1931—34, it is apparent that no important drift of fry has taken place during 1939 on the route found during 1931—34.

T.

Fig. 16. Drift of Cod Larvæ. Investigations 1931—34.

The Icelandic Haddock-Stock in 1939.

In the following table is given the age composition of the Icelandic stock of haddock in the year 1939. Unfortunately I am not in a position to compare the results from the age-analyses with those from previous years, the material collected since 1935 incl. (some 22000 haddock) having not yet been treated. The age determinations were carried out by means of the otoliths, and in cases, where no otoliths were obtained the strengths of the youngest age-classes were calculated according to the length-frequencies, the uncertain part of the material given in the table as "5 years and older" etc.

In the *long-line catches* the brood from 1936 was especially predominant and the same was the case in the year 1938. In 1937 this year-class was caught (as I-group) in enormous quantities in the "Garðsjór", Faxa Bay, so it seems to be very strong. Other dominating year-classes in the long-line fishery were that of 1931 and especially that of the 1935-brood. In the net-fishing at the Westman Islands we find that the 1931-brood is by far the most predominant. In the *trawl-fishery* we find three year-classes (1937, 36 and 35) predominating: 2-year-old haddock in Breida Bay and especially in the Garðsjór, 3-year-old haddock in the deeper areas of the Faxa Bay and 4-year-old haddock in the commercial trawlings off the western part of the S.-coast (Selvogsbanki).

Árni Friðriksson.

Table 12.
Age Composition of the Icelandic Haddock Stock in 1939.

Implement		Long-line			Net.		Trawl			
Coast		SE. coast	SW. coast	N. coast	S. coast	S. coast	SW. coast			
Locality		Hornafj.	Akranes	Axarfj.	Westm. Isl.	Selv.b.	Fax. 1	Fax. 1	Fax. 2	Br. Bay
Month		Febr.	Jan.-Aprl.	Oct.	April	March	Mar.-May	July	Mar.-May	May
Age Years	Brood from									
1	1938	—	—	—	—	—	0·4	3·9	—	1·0
2	1937	1·0	—	—	—	0·8	**60·9**	**62·6**	27·1	**39·1**
3	1936	11·9	**72·3**	**54·4**	—	20·1	38·6	33·5[2])	**62·7**	38·3
4	1935	**31·7**	20·6	**43·9**	—	**45·1**	0·1	—	6·8	15·2
5	1934	24·7	7·1[1])	1·7[1])	2·5	34·0[1])	+	—	1·7	2·1
6	1933	8·9	—	—	19·0	—	—	—	—	4·1
7	1932	6·9	—	—	27·3	—	—	—	—	—
8	1931	**7·9**	—	—	**42·1**	—	—	—	—	0·2
9+	1930—	7·0	—	—	9·1	—	—	—	1·7	—
Total:		100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
Number		101	1648	296	121	1382	6493	2595	59	486

[1]) 5 years and older.
[2]) 3 years and older.

Fax. 1 = The SE. part of the Faxa Bay (the "Garðsjór").
Fax. 2 = The Faxa Bay less Fax. 1.

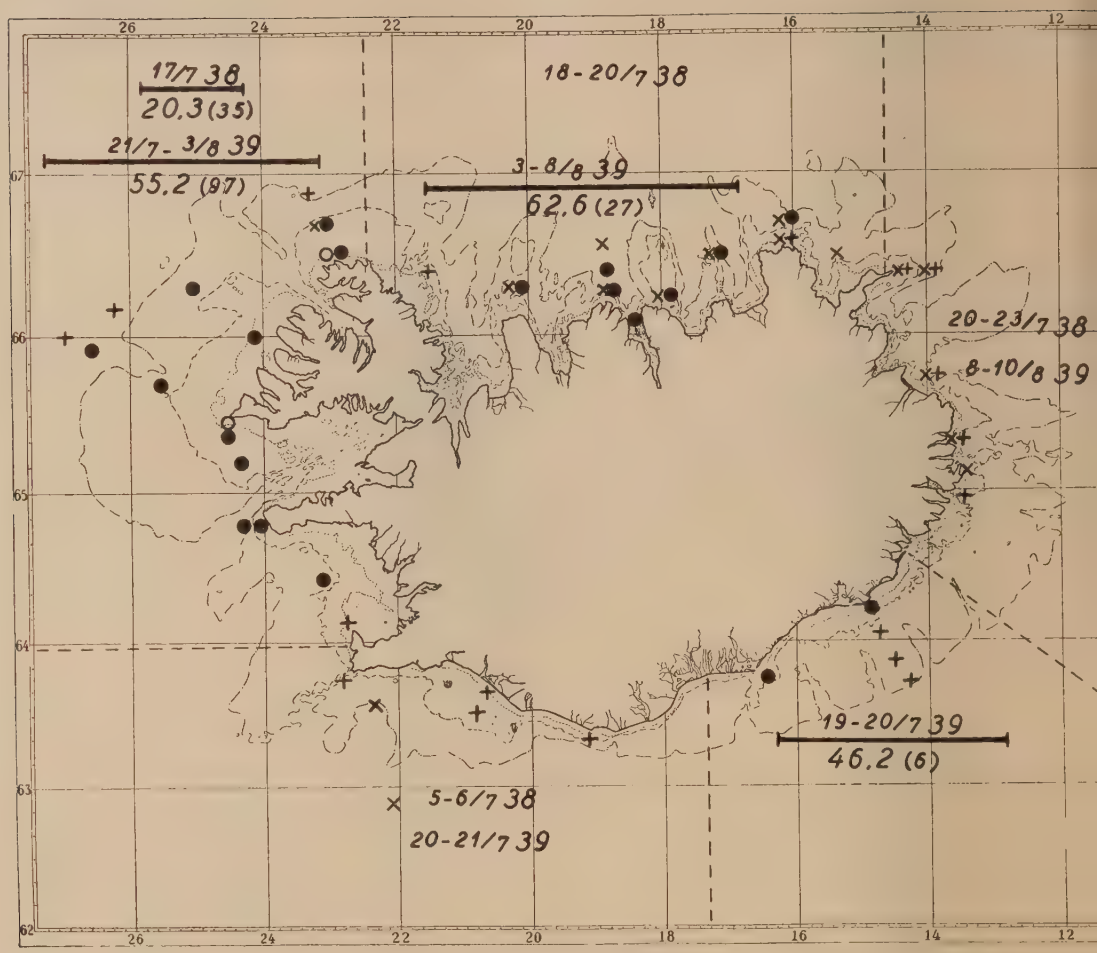


Fig. 17. Distribution and Size of Haddock Fry 1938 and 1939.

For each area, date and year, average size in mm. and number of specimens (in brackets) are given.

	1938	1939
Larvae present	○	●
„ not present	×	+

Drift and Growth of Haddock Larvae.

The drift of haddock larvae from the spawning places off south-west and west Iceland to the north coast shows the same features as those of the cod, viz., a dispersion of larval stages along the entire north coast and a larger size of larvae than normally known.

On the chart we have combined the results of 1939 with those from 1938; as mentioned when dealing with the cod, 1938 and 1939 were two very different years, the latter (1939) being a year with great influx of warm water to the north of Icel the former one (1938) however a year with a influx and no haddock larvae at all along the n coast (this may be caused by the low temperat as the haddock requires slightly higher tempera than the cod).

Compare the chart (Fig. 17) given with hydrographical sections from the north coast, 5—8.

The Icelandic Saithe-Stock in 1939.

In the year 1938 we commenced investigations on the saithe, but the material from this year is too scanty for comparison with the results from 1939. All the material (except the seine-catches from Hafnarfjord) has been age-determined by means of the otoliths, which I find very well suited for the purpose.

A glance at Table 13 shows, that the age-composition in the net- and commercial trawl-catches in the warm-water area agrees very well, as four year-classes were found to be predominating everywhere, viz., the 1931, 1928, 1926 and 1924-year-class. When the great number of age-groups appearing in the catches is kept in mind, we can hardly expect such relatively high percentages of the dominating classes as in the cod investigations; and this fact is obvious from the table. In the spring-fishery off the NW.- and N.-coast we find traces of the dominants found on the spawning grounds, except for the oldest one, but here we find a large number of superfluous six-year-old fish. Later in the year, on the other hand, we find four-year-old fish greatly predominating here and very few of the six-year-old ones.

At several places in Iceland purse-seine fishing of small saithe is carried out in the winter months. More than 2000 from Hafnarfjord (SW.) were investigated in December, showing that the catches were almost entirely composed of the year-class from 1938.

Árni Friðriksson.

Table 13.
Age Composition of the Icelandic Saithe Stock in 1939.

Age (years)	Brood from	Westm. Islands (S.) Net, March-Apr.	S.+SW. coast Tr.[1]), Febr.-May	NW.+N. coast Tr., May	NW. coast Tr., Dec.	Hafnarfj. (SW.) Purse-seine December
0.	1939	—	—	—	—	0·2
1.	**1938**	—	—	—	—	**99·0**
2.	1937	—	—	—	—	0·8
3.	1936	—	0·1	—	3·5	—
4.	**1935**	—	1·4	7·6	**82·7**	-
5.	1934	—	1·3	13·2	8·5	—
6.	**1933**	0·5	5·7	**57·1**	5·3	-
7.	1932	2·0	6·0	2·5	—	
8.	**1931**	**18·2**	**20·0**	**5·6**	—	-
9.	1930	8·0	7·2	0·5	—	—
10.	1929	6·5	5·8	1·0	—	-
11.	**1928**	**21·7**	**15·8**	**3·5**	—	—
12.	1927	3·0	5·7	1·0	—	—
13.	**1926**	**12·1**	**8·2**	**4·5**	—	—
14.	1925	3·0	3·2	1·0	—	—
15.	**1924**	**7·5**	**5·1**	0·5	—	—
16.	1923	5·0	2·8	0·5	—	—
17.	1922	4·5	2·3	—	—	—
18.	1921	2·0	1·5	—	—	—
19.	1920	1·0	1·0	—	—	-
20.	1919	1·0	1·2	—	-	-
21.	1918	0·5	0·4	—	—	—
22.	1917	0·5	0·4	—	—	—
23.	1916	—	0·3	—	—	-
24.	1915	1·0	0·1	—	—	—
25.	1914	—	0·1	—	—	—
26.	1913	—	0·1	—	—	—
?	?	2·0	4·3	1·5	—	—
Total:		100·0	100·0	100·0	100·0	100·0
Number		199	1816	198	399	2131

[1]) Commercial Trawl.

Plaice.

In the following review of the age composition of the stock of plaice the material collected by the "Dana" in 1938 and 1939 has been included. See Tables 14—17 and Fig. 18.

1938.

Age Composition of Trawl Catches:

Only material from the west coast and the east coast is available from this year.

On the west coast, in Faxa Bay, the year-class 1935 predominates with about 60 % in in-shore waters (the territorial station in the southern part of the bay); in the more open waters of Faxa Bay this year-class is as yet insignificant (because it is only three years old), and here we find the year-classes 1933 and 1934 with about 48 % and 38 % respectively.

On the east coast (Hjeradsflói) the year-class 1933 is the best (with 58 %).

Age Composition of Eel-Hand-Sein Catches:

Only material from the north and east coast available and in both localities the year-class 19 is by far the strongest (with about 70 % and 82 % respectively).

A total of only 991 plaice from the cruise 19 have been determined as to age.

1939.

Age Composition of Trawl Catches:

Table 16 shows that the *year-class 1935 (I group) was prominent at nearly all localities* whe experimental trawling has been carried out. Th year-class was present with 60—80 % in five o of seven trawling-localities. This age-distributio was to be expected according to the investigatio during 1938. A small sample from *the south coa* shows however the year-class 1936 to be better; t

Table 14.

Age Composition of Plaice from Iceland Grounds 1938. Trawl Catches.

Age-groups/Year-classes. Number and percentages.

Area	Locality Date	II 1936	III 1935	IV 1934	V 1933	VI 1932	VII 1931	VIII 1930	IX 1929	Total	Gear[1] Duration in hours	Total catch
West	Faxa Bay Territorial St. 5970. 12—13/7.	12 **4·0**	180 **60·4**	68 **22·8**	32 **10·7**	5 **1·7**	1 **0·3**	— —	— —	298	OT 10 h.	445
	Faxa Bay Extra-territorial St. 5969. 11/7.	— —	5 **8·4**	23 **38·3**	29 **48·3**	1 **1·7**	2 **3·3**	— —	— —	60	OT 10 h.	60
East	Hjeraðsflói St. 5994. 21/7.	— —	— —	19 **23·5**	47 **58·0**	5 **6·2**	5 **6·2**	3 **3·7**	2 **2·5**	81	OT 3 h.	81

Table 15.

Age Composition of Plaice from Coastal Waters. 1938. Eel-hand-seine.

		0 1938	I 1937	II 1936	III 1935	IV 1934	Total
North	Husavik St. 5985. 19/7. (2 hauls)	— —	87 **21·7**	28 **7·0**	279 **69·6**	7 **1·7**	401 —
East	Seydisfjord St. 5997. 22/7. (5 hauls)	— —	2 **1·3**	14 **9·3**	124 **82·1**	11 **7·3**	151 —

[1]) CT = Commercial trawl; OT = 50′ Ottertrawl.

cause of this may be that the intense fishing with Danish seine in these waters has removed the greater part of the larger specimens of the 1935-brood; the 1936 year-class, however, has been rather poor in other Icelandic waters according to the eel-hand-seine samples 1938 and 1939. From *the east coast* a sample shows three year-classes (1933, 1934, 1935) as rather good, each about one third of the total catch.

Age Composition of Eel-Hand-Seine and Hand-Shove-Net Catches in Coastal Waters:

The *eel-seine* was operated on the north coast (Skjálfandi Bay) and on the east coast (Seydisfjord). In addition the *hand-shove-net* was operated on the north coast (Skjálfandi Bay). On the north coast the catches show that the three youngest age-groups (0-group—II-group) were well represented. On the east coast the catches were poor, showing that the 1935-brood practically had left the coastal waters, where it had been dominant the preceding year (1938) as the III-group; no good year-class had replaced the 1935 year-class in the fjord operated (Seydisfjord).

A total of 2350 plaice from the cruise 1939 have been determined as to age.

T.

Table 16.

Age Composition of Plaice from Iceland Grounds 1939. Trawl Catches.

Age-groups/Year-classes. Number and percentages.

Area	Locality Date	II 1937	III 1936	IV 1935	V 1934	VI 1933	VII 1932	VIII 1931	X+ 1929-	Total	Gear[1]) Duration in hours	Total catch
South-east	Lónsvík	1	23	264	94	7	—	—	2	391	CT	539
	St. 6112. 19/7.	**0·3**	**5·9**	**67·5**	**24·0**	**1·8**	—	—	**0·5**		1 h.	
	Ingolfshöfdi	—	1	20	4	—	—	—	—	25	CT	25
	St. 6114. 20/7.	—	**4·0**	**80·0**	**16·0**	—	—	—	—		1 h.	
South	Landeyasandr	1	26	11	4	1	—	—	—	43	CT	43
	St. 6116. 20/7.	**2·3**	**60·5**	**25·6**	**9·3**	**2·3**	—	—	—		1 h.	
West	Faxa Bay Territorial	11	65	183	24	3	—	2	—	288	OT 6 h.	387
	St. 6176. 28—29/7.	**3·8**	**22·6**	**63·5**	**8·4**	**1·0**	—	**0·7**	—			
	Faxa Bay Extra-territorial	1	9	44	7	11	—	—	1	73	OT 6 h.	73
	St. 6177. 29/7.	**1·4**	**12·4**	**60·2**	**9·6**	**15·1**	—	—	**1·4**			
North	Skjálfandi Bay	—	12	40	13	1	—	—	—	66	OT	66
	St. 6215. 7/8.	—	**18·2**	**60·6**	**19·7**	**1·5**	—	—	—		2 h.	
East	Hjéradsflói	—	3	69	95	56	2	—	1	226	OT	434
	St. 6224. 9/8.	—	**1·3**	**30·5**	**42·0**	**24·8**	**0·9**	—	**0·4**		2 h.	

[1]) CT = Commercial trawl; OT = 50′ Ottertrawl.

Table 17.

Age Composition of Plaice from Icelandic Coastal Waters 1939.

			0 1939	I 1938	II 1937	III 1936	IV 1935	Total
North	Eel-hand-seine	Husavik	50	578	164	32	59	883
		Skálfandi Bay	**5·7**	**65·5**	**18·6**	**3·6**	**6·7**	
		7—8/8. (6 hauls)						
	Hand-shove-net	„	232	32	—	—	—	264
		(1 man 1½ hour)	**87·9**	**12·1**	—	—	—	
East	Eel-hand-seine	Seydisfjord	—	19	16	3	18	56
		9/8. (6 hauls)	—	**33·9**	**28·6**	**5·4**	**32·1**	

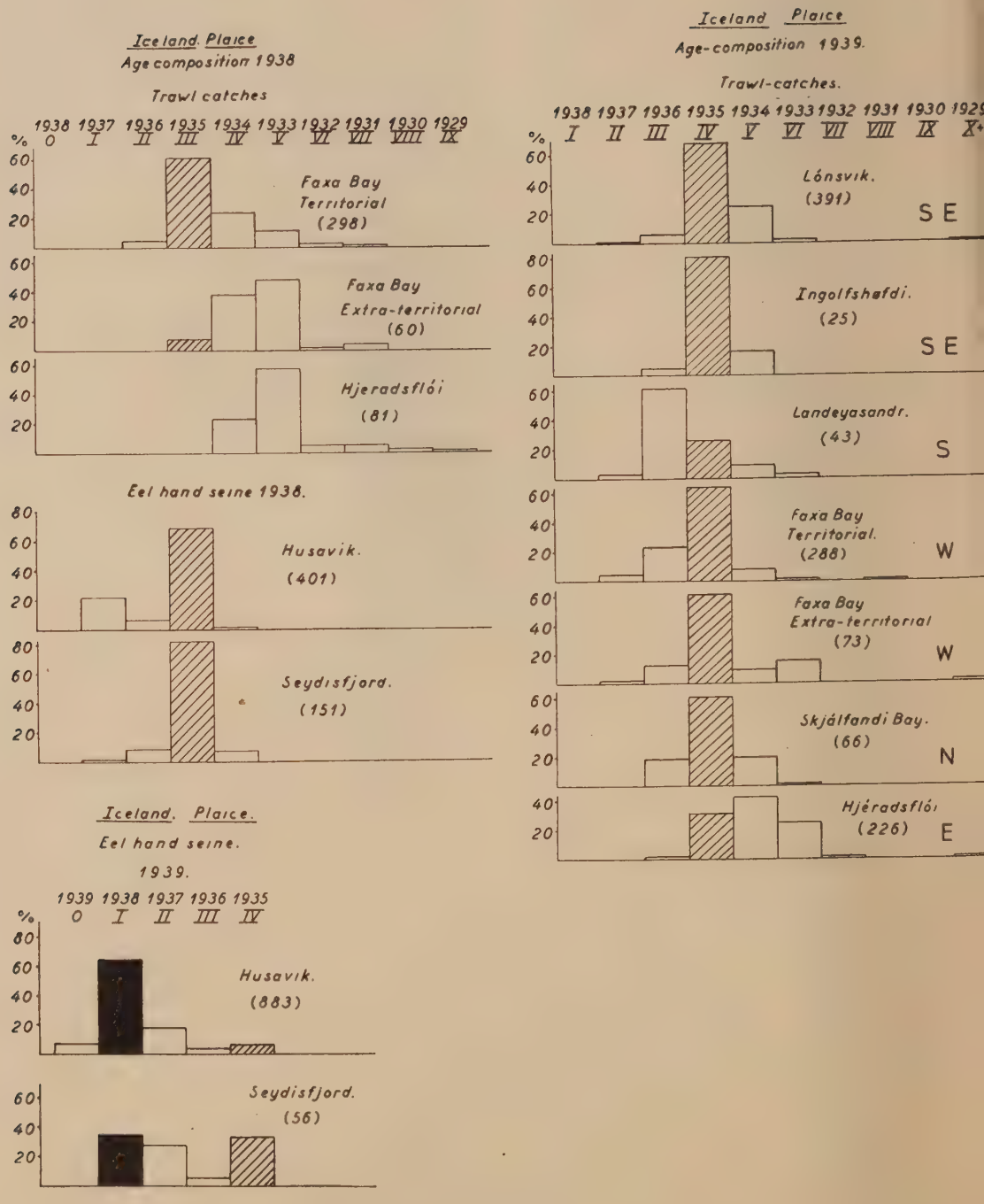
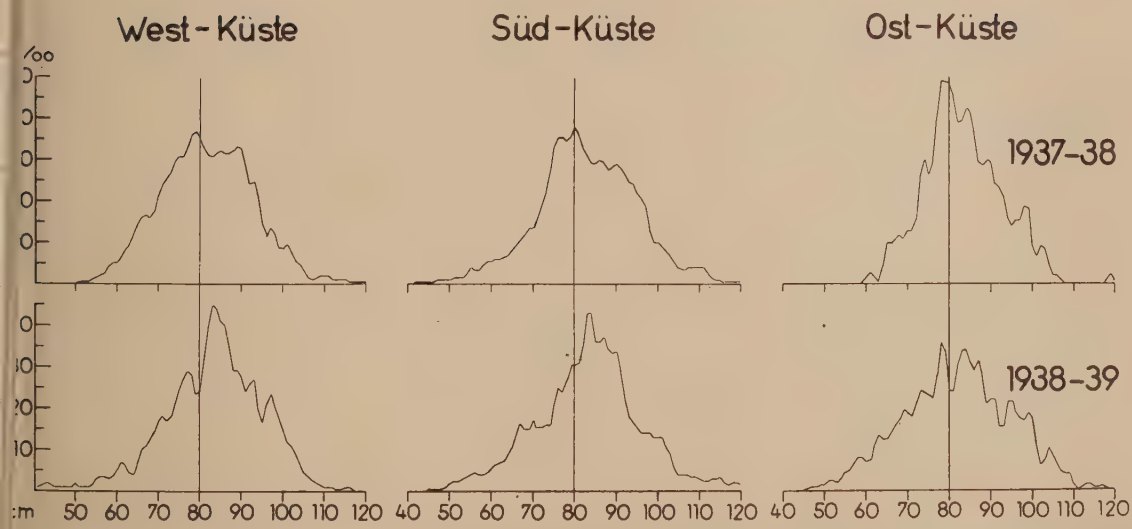

Iceland. Plaice
Age composition 1938
Trawl catches
1938 1937 1936 1935 1934 1933 1932 1931 1930 1929
% 0 I II III IV V VI VII VIII IX
Faxa Bay Territorial (298)
Faxa Bay Extra-territorial (60)
Hjeradsflói (81)
Eel hand seine 1938.
Husavik. (401)
Seydisfjord. (151)
Iceland. Plaice.
Eel hand seine.
1939.
1939 1938 1937 1936 1935
% 0 I II III IV
Husavik. (883)
Seydisfjord. (56)
Iceland Plaice
Age-composition 1939.
Trawl-catches.
1938 1937 1936 1935 1934 1933 1932 1931 1930 1929
% I II III IV V VI VII VIII IX X+
Lónsvik. (391) SE
Ingolfshafdi. (25) SE
Landeyasandr. (43) S
Faxa Bay Territorial. (288) W
Faxa Bay Extra-territorial (73) W
Skjálfandi Bay. (66) N
Hjéradsflói (226) E

Fig. 18.

Grössenzusammensetzung der deutschen Fänge um Island 1937—1939.



ig. 19. Relative Längenzusammensetzung je Tausend der deutschen **Kabeljau**-Anlandungen von der West-, Süd- und stküste Islands in den Jahren 1937—39. (Die Reihen sind nach der Formel $[(n-1)+2n+(n+1)]:4$ geglättet. Vergleichsmaterial von früheren Jahren liegt nicht vor.)

Kabeljau (Fig. 19).

Auffallend ist die ziemlich gleichmässige Grössenzusammensetzung sowohl in den beiden Jahren wie auch in den verschiedenen Küstengebieten. Das Längenmaximum liegt 1937/38 bei 80 cm., 1938/39 um etwa 5 cm. höher. Dieser Unterschied ist wohl als der Ausdruck des Wachstums eines Jahres anzusehen.

Schellfisch (Fig. 20).

Bemerkenswert sind die auffallenden Unterschiede in der Grössenzusammensetzung sowohl zwischen den einzelnen Küstengebieten wie auch zwischen den beiden Jahren. 1937/38 bestehen die Schellfischfänge von der Südküste vorwiegend aus mittelgrossen Tieren (Maximum bei 56 cm.). An der Ostküste finden wir neben einer Gruppe mittelgrosser Fische (Längen um 60 cm.) eine scharf abgesetzte Gruppe kleinerer Tiere mit Längen um 40 cm. 1938/39 sind die Mittelgrössen in allen Gebieten stark zurückgegangen, dafür treten aber die kleineren Tiere ganz besonders hervor, namentlich an der West- und Ostküste (40—45 cm.). An der Südküste findet man neben einer Hauptgruppe kleinerer noch eine deutlich hervortretende Gruppe kleinster Tiere mit Längen von 30—40 cm. Anscheinend wächst hier bei Island eine breite Welle junger Schellfische heran, die die Erträge der Fischerei in den kommenden 2—3 Jahren wahrscheinlich günstig beeinflussen wird.

Köhler (Fig. 21).

Folgende Besonderheiten sind hervorzuheben. 1937/38 finden wir jüngere Köhler fast ausschliesslich an der Westküste, während die Mittelgrössen

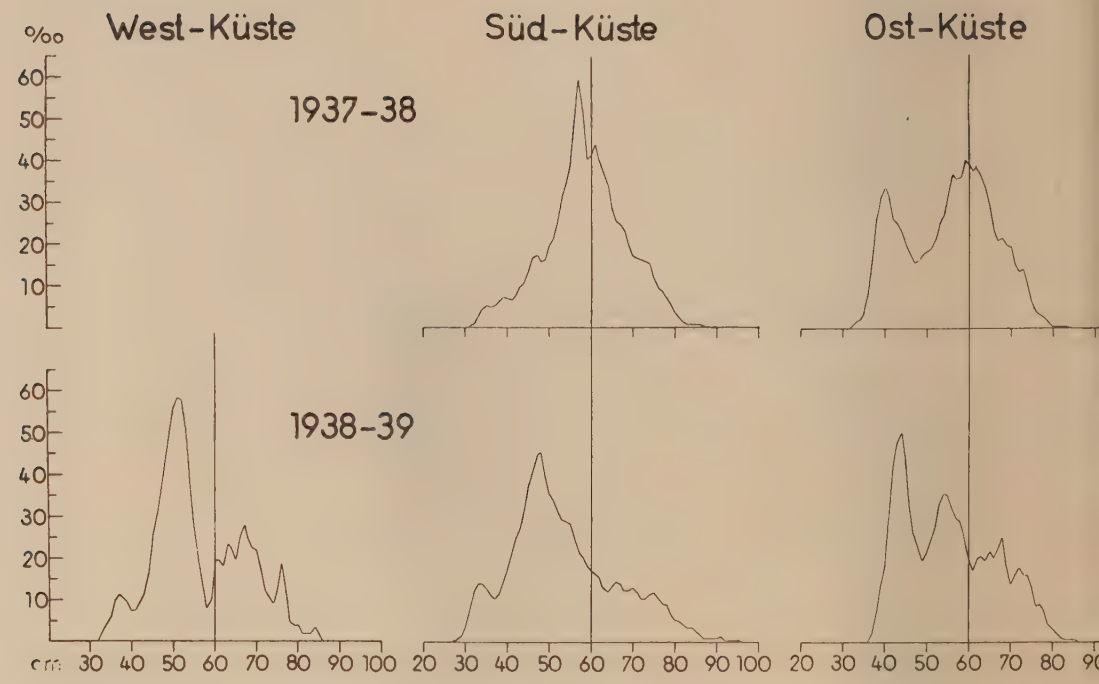


Fig. 20. Relative Längenzusammensetzung je Tausend der deutschen **Schellfisch**-Anlandungen von der West-, Süd Ostküste Islands in den Jahren 1937—39 (Glättung wie bei der Fig. 19. Für 1937/38 liegen keine Messungen für die küste vor.)

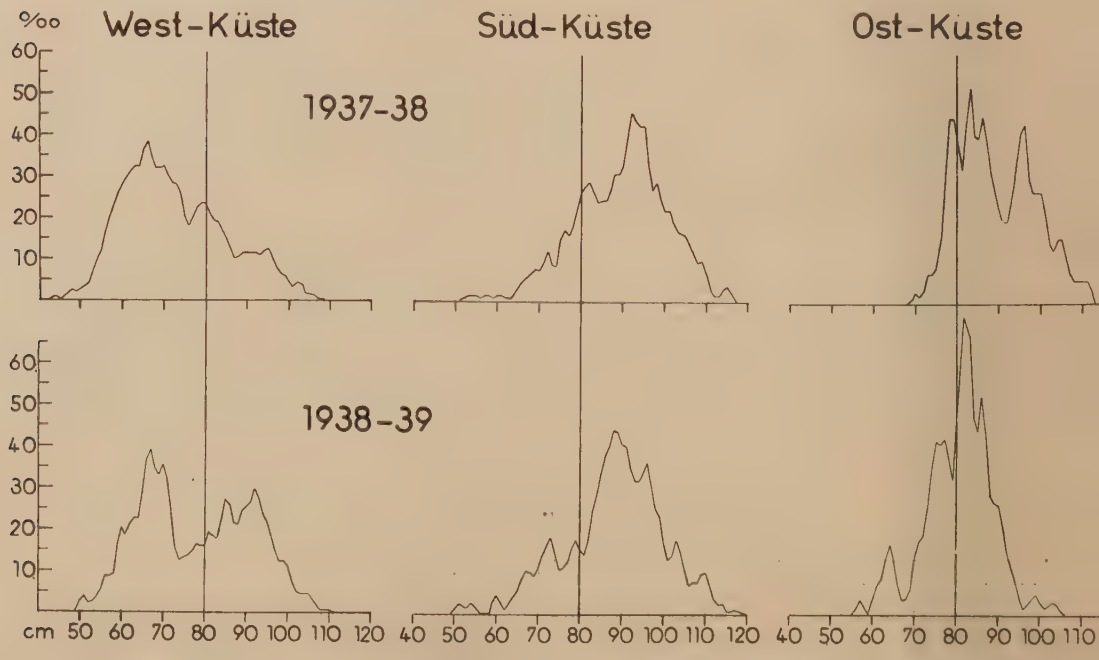


Fig. 21. Relative Längenzusammensetzung je Tausend der deutschen **Köhler**-Anlandungen von der West-, Süd- und küste Islands in den Jahren 1937—39. (Glättung wie bei Fig. 19 und 20.)

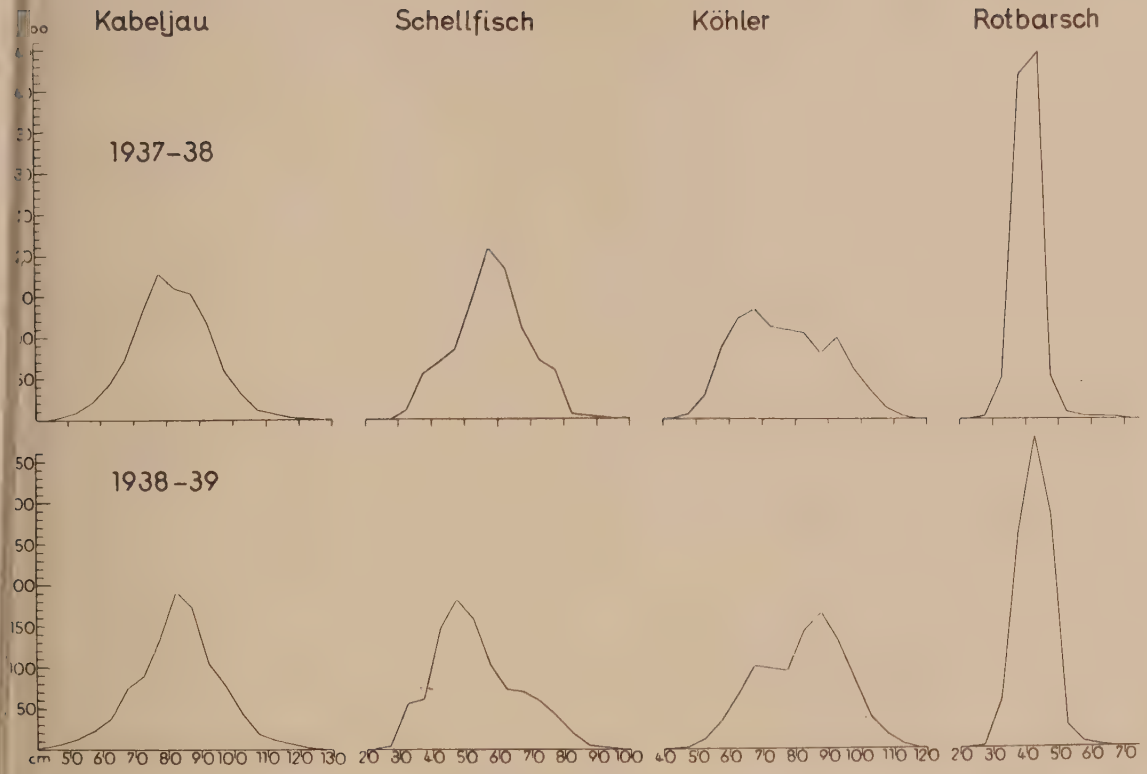


Fig. 22. Relative Grössenzusammensetzung der gesamten deutschen Kabeljau-, Schellfisch-, Köhler- und Rotbarsch-Anlandungen aus den isländischen Gewässern in den Jahren 1937—39. (Nicht geglättete Zahlenreihen zu je 5 cm.-Gruppen vereinigt).

um 80 cm. in der Hauptsache an der Ost- und in geringerem Masse an der Südküste anzutreffen sind. Die grossen Tiere wurden im wesentlichen von der Süd- und in geringerem Masse auch von der Ostküste gelandet. 1938/39 ist die Grössenverteilung im Prinzip die gleiche geblieben. Es tritt allerdings in diesem Jahre auch an der Westküste eine deutliche Gruppe grosser Köhler (um 95 cm.) hervor, während diese an der Ostküste fast gänzlich fehlt, dafür ist dort der Anteil der Mittelgrössen besonders hoch. Den Hauptanteil grosser Fische liefert wieder die Südküste. Ganz junge Tiere (unter 60 cm.) finden sich nur in ganz geringen $^0/_{00}$-Sätzen an der Westküste.

(Fig. 22).

Beim **Kabeljau** ist 1938/39 gegenüber dem Vorjahr eine Verschiebung des Kurvengipfels von 77 auf 82 cm. festzustellen. Der Anteil grosser Tiere hat zugunsten der Mittelgrössen abgenommen. Sonst keine Veränderungen von nennenswerter Bedeutung. — In den **Schellfisch**anlandungen macht sich 1938/39 sehr deutlich die bereits festgestellte Verjüngung des Bestandes bemerkbar. Anteilsmässig sind die kleinen Tiere (30—50 cm.) den mittelgrossen und grossen erheblich überlegen, während 1937/38 die Mittelgrössen (Gipfel bei 62 cm.) bei weitem überwogen. — In den **Köhler**anlandungen waren 1937/38 Grössen von 60—90 cm. mit ziemlich gleich hohen Anteilen vertreten. 1938/39 traten die Fische mit Längen um 90 cm. besonders hervor. Der Anteil junger Fische war in beiden Jahren relativ gering. Anzeichen stärkeren Nachwuchses sind nicht vorhanden. — Für den **Rotbarsch** sind nur die Kurven der Gesamtanlandungen gegeben, da kaum Unterschiede in der Grössenzusammensetzung in den einzelnen Küstengebieten festzustellen sind. Augenfällig ist die weitestgehende Übereinstimmung im Verlauf der Kurven beider Jahre. Die Hauptmasse der Anlandungen bestand in beiden Jahren aus Tieren mit Längen von 35—45 cm.; die Anteile der grösseren Fische sind zwar etwas höher als die der kleineren, spielen aber im Vergleich zum Hauptanteil der Mittelgrössen keine Rolle.

Adolf Kotthaus.

Greenland.

Cod.

A general survey is given of the age composition of the stock of cod in West-Greenland waters in the years 1924 to 1938 in a paper published in Rapport et Proc.-Verb., Vol. No. 109, 1939. In the present Tab. 18 (p. 108/9) the percentages of the age-groups collected in these years are shown, the material collected in 1939 is included. The otoliths have been used for the determination of age. The III-group has been excluded as not-representative.

The material is divided into three groups according to different areas shown on the annexed chart. In the tables the rich year-classes are seen very clearly. In Table 18 and Fig. 24 the age composition is given in percentages of the whole material collected at Greenland (the three areas taken together). The predominating year-classes being 1917, 1922, 1924, 1926, 1931, 1932 and 1934.

In Table 19 the average size is given of the different age-groups in the northern and southern area and of the offshore banks.

The average lengths of the age-groups are in most cases based on a great number of observations; when the number of observations was less than ten, the value of the average length is recorded in brackets.

In Table 20 the average-size of individual year-

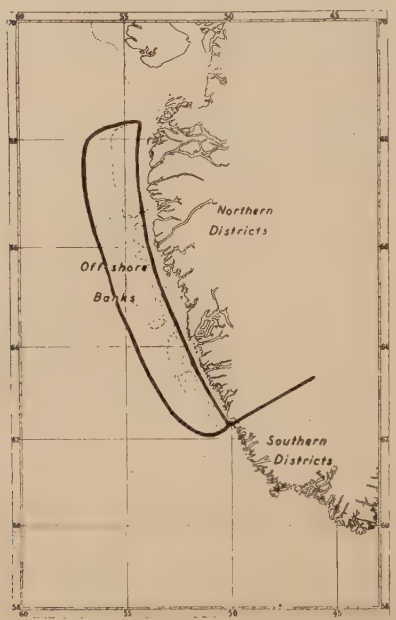


Fig. 23. Areas considered in the Text.

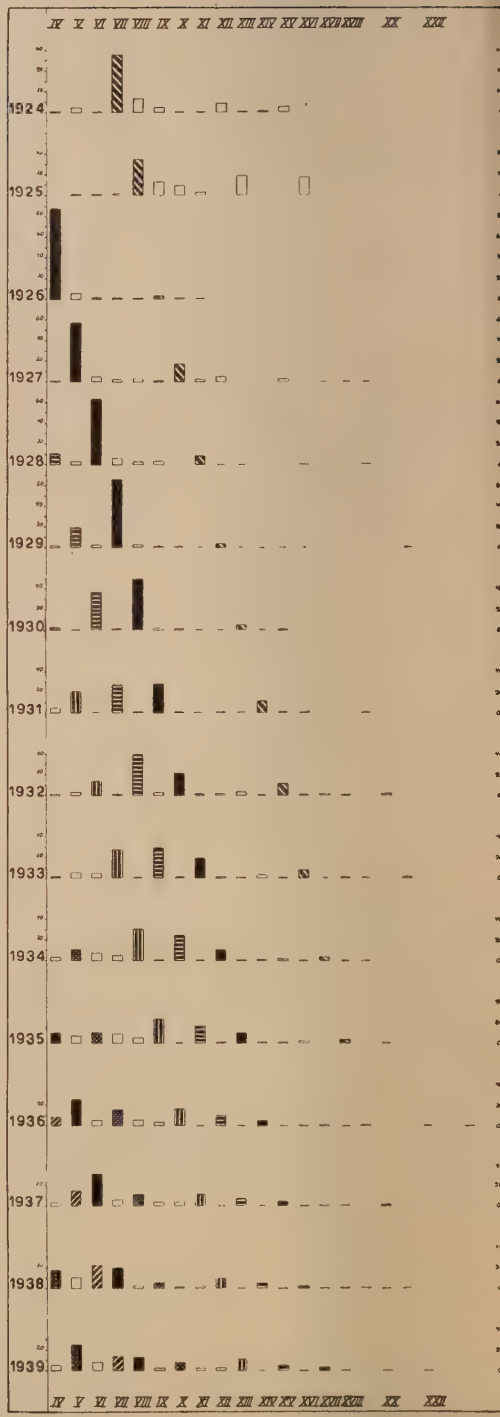


Fig. 24. Age Composition of Cod in Greenland Water

ses is given at different ages in the northern and hern area and on the offshore banks.

t is seen that in most years the growth is slower he southern than in the northern area, but in last one or two years the values of the average ths of the corresponding age-groups are almost al in the two areas, especially with regard to the en youngest year-classes.

The average lengths of the age-groups of the 7 year-class are higher than those of the cor- onding age-groups of the other rich year-classes, the 1922, 1924 and 1926 year-class. Also the rage lengths of the age-groups of the 1922 year- s seem to be higher compared with the other r-classes.

Marking experiments have been con- ied at West Greenland during 16 years and a iew of the results is given in Table 11. In ole 21 some particulars are however more closely sidered. This table shows the age determinations sed on otoliths of cod marked at Greenland and captured at Greenland and Iceland in the different urs.

If we compare the number of recaptures of the different year-classes at Iceland and at Greenland it appears that there is a great difference between the two materials.

At Greenland the three rich year-classes: 1922, 1924, and 1926, are almost equally represented; in the material from Iceland the year-classes 1922 and 1924 are more prominent while the year-class 1926 is of small importance, having a much smaller number of emigrants than the other two.

Cod of the year-class 1931 seems to have migrated to Iceland in large numbers in spite of being taken only as seven and eight-year-old cod; this year-class is number three among the important year-classes, and in the Greenland material it is only slightly represented.

Also the year-class 1929 is very poorly represented in the Greenland material; at Iceland, however, it seems to be of some importance.

Besides the strength of the year-classes of migrating cod the table also shows the difference in number of recaptures at Iceland in the various years. In the years 1936, and 1937, only very few marked Greenland cod have been taken in Icelandic waters.

Paul M. Hansen.

Table 18.

Age Composition in Percentages (III-Gr. omitted), Greenland Cod.

Northern Districts.

Year	No. analysed	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV	XXV	XXVI	
1924	301	0·7	5·3	1·7	62·6	13·9	5·3	1·0	0·3	3·3	0·3	2·0	3·6	—	—	—	—	—	—	—	—	—	—	—	1924
1926	315	87·9	6·0	1·0	1·3	0·3	2·5	0·6	0·3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1926
1927	138	2·2	78·3	1·5	2·9	3·6	0·7	8·7	0·7	0·7	—	—	0·7	—	—	—	—	—	—	—	—	—	—	—	1927
1928	271	11·8	3·3	64·6	7·0	1·5	2·6	—	7·4	0·7	—	—	—	0·4	—	—	0·7	—	—	—	—	—	—	—	1928
1929	421	2·5	18·9	4·7	63·1	3·6	0·7	1·4	0·7	2·5	0·4	0·4	—	0·4	—	—	—	—	0·7	—	—	—	—	—	1929
1930	300	5·3	1·3	31·7	0·7	48·0	1·7	1·3	0·3	1·0	7·0	0·7	0·7	—	—	0·3	—	—	—	—	—	—	—	—	1930
1931	1422	6·0	23·6	0·7	24·1	1·4	26·2	0·8	1·3	1·1	0·2	13·6	0·2	0·1	—	—	0·6	—	—	—	—	—	—	—	1931
1932	588	1·9	2·6	10·5	0·7	28·4	1·2	17·9	0·2	0·9	5·1	0·9	25·9	1·0	1·9	1·2	—	—	—	—	—	—	—	—	1932
1933	2304	1·8	7·1	5·2	28·3	0·6	22·1	0·9	17·8	0·8	0·4	3·4	0·2	10·2	0·2	0·4	0·1	—	0·7	—	—	—	—	—	1933
1934	3925	5·8	11·4	8·6	4·7	29·0	0·7	16·8	0·9	12·6	0·7	0·9	2·4	0·1	5·2	—	0·2	—	—	0·1	—	—	—	—	1934
1935	2874	10·9	9·8	8·3	9·6	5·6	21·4	0·5	13·4	1·2	10·9	0·7	0·9	2·5	—	4·2	—	0·1	—	—	—	—	—	—	1935
1936	2744	7·3	24·6	5·4	9·8	4·8	3·9	18·8	0·5	12·0	1·0	6·7	0·8	0·7	1·4	0·2	2·0	—	—	—	—	0·1	—	—	1936
1937	1523	4·4	14·3	21·9	3·6	5·8	5·1	5·2	18·1	0·6	11·5	0·9	5·7	0·5	0·7	0·7	—	1·3	—	—	—	—	—	—	1937
1938	1622	18·6	7·5	20·6	16·7	2·6	6·1	2·8	2·3	13·2	0·3	6·2	0·1	2·3	0·1	0·1	0·3	0·1	0·3	—	—	—	—	—	1938
1939	2260	3·4	19·7	5·1	13·1	15·1	3·1	7·6	3·1	4·3	16·0	0·1	6·0	0·1	2·8	0·1	—	0·2	—	0·2	—	—	—	—	1939
	21008																								

Southern Districts.

1927	124	—	33·9	8·9	2·4	2·4	2·4	27·4	4·8	9·7	—	—	5·7	—	0·8	0·8	0·8	—	—	—	—	—	—	—	1927
1929	579	0·9	19·2	0·4	67·4	3·1	1·6	1·2	0·2	4·8	0·4	0·7	0·2	—	—	—	—	—	0·2	—	—	—	—	—	1929
1930	1729	18·5	0·5	38·1	1·8	49·9	1·6	0·5	0·2	0·2	4·4	—	0·6	—	0·4	0·1	—	0·6	—	—	—	—	—	—	1930
1931	174	—	8·6	—	62·6	2·3	25·9	0·6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1931
1932	987	0·2	0·6	9·9	1·6	61·1	1·3	17·1	0·5	0·5	0·1	—	5·8	0·1	0·4	0·1	—	0·6	—	—	—	—	—	—	1932
1933	671	0·2	1·2	2·8	25·3	0·9	50·2	0·6	14·6	0·5	—	0·9	—	2·5	0·2	—	—	—	0·2	—	—	—	—	—	1933
1934	2296	1·2	9·8	5·7	4·0	32·5	0·9	38·4	0·3	5·8	0·1	—	0·3	—	0·9	—	—	—	—	—	—	—	—	—	1934
1935	1182	9·6	2·9	15·1	8·8	4·5	27·4	0·4	23·4	0·1	7·0	—	—	0·3	—	0·5	—	—	—	—	—	—	—	—	1935
1936	1689	12·3	29·1	4·9	26·4	5·6	2·1	10·8	0·3	5·6	0·1	2·3	—	0·1	0·1	—	0·5	—	—	—	—	0·1	—	—	1936
1937	1443	4·6	20·7	39·8	7·8	13·3	2·2	2·1	3·6	0·2	2·8	—	2·6	—	0·2	—	—	0·1	—	—	—	—	—	—	1937
1938	1529	16·7	14·6	26·6	22·8	2·2	3·9	0·6	1·4	4·6	0·1	3·7	—	2·2	—	—	0·2	—	0·3	—	—	—	—	0·1	1938
1939	1151	10·0	30·6	13·5	16·6	9·3	1·1	5·1	0·8	2·2	5·5	—	3·2	—	1·7	—	—	0·1	—	0·4	—	—	—	—	1939
	13554																								

Offshore Banks.

Year	No. analysed	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	
1924	41	—	—	—	7·3	9·8	9·8	—	—	51·1	—	—	22·0	—	—	—	—	1924
1925	108	—	0·9	0·9	1·9	35·1	13·0	9·3	2·8	—	18·5	—	—	17·6	—	—	—	1925
1926	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1926
1927	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1927
1928	34	—	5·9	58·9	—	8·8	8·8	—	14·7	—	2·9	—	—	—	—	—	—	1928
1929	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1929
1930	113	8·8	0·9	18·6	1·8	52·2	3·5	—	—	—	14·2	—	—	—	—	—	—	1930
1931	171	1·2	14·6	2·3	23·4	4·7	43·2	4·1	0·6	2·3	1·2	2·3	—	—	—	—	—	1931
1932	574	0·9	5·2	22·0	0·3	15·5	7·3	31·6	3·0	2·8	3·5	0·3	7·0	0·3	0·3	—	—	1932
1933	401	1·0	5·5	3·7	19·3	0·7	29·2	2·3	35·2	0·5	0·7	0·5	—	1·2	—	—	—	1933
1934	348	0·6	7·7	14·4	13·5	29·6	0·9	18·1	1·4	11·5	0·6	1·4	0·3	—	—	0·2	—	1934
1935	298	2·7	4·4	7·7	6·4	7·0	32·2	1·7	18·8	2·3	12·8	0·3	0·3	2·7	—	—	—	1935
1936	301	1·0	22·6	8·0	11·3	6·6	9·0	24·6	0·6	7·0	1·0	7·0	—	—	1·0	—	0·3	1936
1937	471	0·6	4·1	32·7	5·9	17·6	4·7	5·5	20·2	0·4	4·1	0·2	3·8	—	0·2	—	—	1937
1938	297	10·4	6·1	9·4	26·5	7·4	6·4	4·1	4·4	15·8	—	6·7	0·3	2·0	—	—	0·5	1938
1939	205	8·3	57·5	8·8	8·8	8·3	0·5	1·5	1·5	1·0	3·4	—	0·5	—	—	—	—	1939
	3362																	

All Greenland, Coasts and Banks.

Year	No. analysed	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV	XXV	XXVI	
1924	342	0·6	4·7	1·5	55·8	13·5	5·8	0·9	0·3	9·0	0·3	1·7	5·8	—	—	—	—	—	—	—	—	—	—	—	1924
1925	108	—	0·9	0·9	1·9	35·1	13·0	9·3	2·8	—	18·5	—	—	17·6	—	—	—	—	—	—	—	—	—	—	1925
1926	315	87·9	6·0	1·0	1·3	0·3	2·5	0·6	0·3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1926
1927	262	1·1	57·3	5·0	2·7	3·1	1·5	17·6	2·7	5·0	—	—	3·1	—	0·3	0·3	0·3	—	—	—	—	—	—	—	1927
1928	305	10·5	3·6	63·9	6·2	2·3	3·3	—	8·2	0·7	0·3	—	—	0·3	—	—	0·7	—	—	—	—	—	—	—	1928
1929	1003	1·6	19·0	2·2	65·4	3·3	1·2	1·3	0·4	3·9	0·4	0·6	0·1	0·2	—	—	—	—	0·4	—	—	—	—	—	1929
1930	2143	2·7	0·6	36·2	1·6	49·7	1·7	0·6	0·2	0·3	5·3	0·1	0·6	+	—	0·4	—	—	—	—	—	—	—	—	1930
1931	1767	4·9	21·3	0·8	27·8	1·8	27·8	1·1	1·1	1·1	0·3	11·2	0·2	0·1	—	—	0·5	—	—	—	—	—	—	—	1931
1932	2149	0·8	2·4	13·3	1·0	40·0	2·9	21·2	1·1	1·2	2·4	0·3	11·6	0·4	0·8	+	—	0·6	—	—	—	—	—	—	1932
1933	3376	1·4	5·7	4·5	26·6	0·7	28·5	1·0	19·2	0·7	0·4	2·5	0·1	7·6	0·1	0·3	0·1	—	0·5	—	+	—	—	—	1933
1934	6569	3·9	10·6	7·9	4·9	30·3	0·8	24·4	0·7	10·2	0·5	0·6	1·6	0·1	3·4	+	0·1	—	—	+	—	—	—	—	1934
1935	4354	10·0	7·6	10·1	9·1	5·4	23·8	0·6	16·5	0·9	10·0	0·5	0·6	1·9	—	3·0	—	0·1	—	—	—	—	—	—	1935
1936	4734	8·7	26·1	5·4	15·8	5·2	3·6	16·3	0·4	9·4	0·7	5·1	0·4	0·4	0·9	0·1	1·4	—	—	+	—	0·1	—	—	1936
1937	3437	4·0	15·6	30·9	5·7	10·6	3·8	3·9	12·3	0·4	6·8	0·4	4·2	+	0·4	0·3	—	0·6	—	—	—	—	—	—	1937
1938	3448	17·1	10·5	22·3	20·3	2·8	5·2	1·9	2·1	9·6	0·2	5·1	0·1	2·2	+	0·1	0·3	+	0·3	—	—	—	—	+	1938
1939	3616	5·8	25·3	8·0	14·0	12·9	2·4	6·5	2·3	3·4	11·9	0·1	4·8	0·1	2·3	0·1	—	0·1	—	0·2	—	—	—	—	1939
	37928			**1934**		**1932**	**1931**					**1926**		**1924**		**1922**					**1917**				

Northern Districts.

Year	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Average X
1924	—	—	66·8	(68·0)	79·2	87·1	90·9	—	—	102·5	
1926	39·5	52·8	66·4	(77·8)	(81·8)	(85·5)	(91·9)	(91·5)	(102·5)	—	
1927	(38·8)	(54·8)	66·6	(81·0)	(78·5)	(84·5)	(71·5)	95·1	(94·5)	(86·5)	
1928	—	60·0	(65·7)	75·4	83·1	(83·0)	(86·6)	—	97·8	(108·0)	
1929	—	(58·0)	63·3	66·5	74·9	(75·0)	(85·2)	(84·5)	(100·8)	—	
1930	—	56·8	(66·8)	67·9	(74·0)	84·9	(96·3)	(95·5)	96·5	(111·5)	10
1931	46·4	57·8	67·4	71·3	75·5	83·5	90·3	97·9	101·4	101·4	(10
1932	(47·5)	56·2	67·9	71·3	(78·8)	80·7	(91·2)	93·0	(96·5)	(102·1)	10
1933	43·1	53·5	62·0	68·6	74·1	75·3	83·1	85·5	93·0	102·2	9
1934	41·0	51·6	62·1	70·4	75·0	79·1	82·3	86·7	89·5	93·7	9
1935	43·6	53·2	60·5	69·2	73·6	79·0	83·2	84·1	89·6	93·9	9
1936	40·4	53·5	64·2	70·6	73·3	79·1	83·5	85·0	88·3	91·3	9
1937	44·1	54·9	63·4	71·1	76·6	80·6	83·8	85·6	88·3	(89·8)	9
1938	35·8	52·7	63·1	67·9	74·5	79·5	81·0	85·6	85·8	90·4	(8
1939	(38·0)	47·4	60·2	66·9	70·9	77·8	83·0	83·5	85·1	88·0	9

Southern Districts.

Year	III	IV	V	VI	VII	VIII	IX	X	XI	XII	X
1927	—	—	66·0	75·1	(81·5)	(88·5)	(92·8)	95·9	(96·0)	104·3	
1929	36·6	50·1	55·0	(66·5)	73·4	83·2	(91·8)	(87·2)	95·5	100·6	(10
1930	—	50·4	59·8	61·8	68·8	77·7	91·4	(93·8)	98·8	(99·3)	10
1931	—	—	58·2	—	69·4	76·8	85·9	102·5	—	—	
1932	—	(58·5)	(59·5)	64·3	68·3	72·6	78·1	85·3	95·5	(106·9)	(8
1933	—	(41·5)	60·5	66·3	70·4	(75·3)	79·8	(78·0)	87·8	(86·5)	
1934	35·5	43·2	53·4	61·2	66·3	72·1	73·0	78·2	80·8	83·0	(7
1935	36·2	46·0	57·6	66·2	71·3	73·6	78·7	(79·3)	82·8	—	8
1936	40·4	51·9	62·4	68·6	75·1	79·6	79·8	83·8	(88·1)	86·5	(10
1937	41·5	52·7	61·9	70·6	75·6	81·7	81·8	84·6	86·5	(82·8)	8
1938	39·8	53·1	59·9	68·5	75·8	80·3	82·5	(84·5)	83·8	89·5	(9
1939	(37·4)	48·3	60·0	66·0	72·4	78·5	81·6	85·9	(86·8)	91·4	9

Offshore Banks.

Year	IV	V	VI	VII	VIII	IX	
1924	—	—	—	(85·8)	(87·8)	(92·5)	
1925	—	—	—	—	82·1	89·4	9
1928	—	(71·5)	78·0	—	(86·8)	(93·8)	
1930	62·4	—	74·2	—	87·9	(93·8)	
1931	(57·0)	65·9	(70·0)	77·0	(85·4)	87·7	(8
1932	(56·7)	66·3	71·9	(77·5)	82·6	85·0	9
1933	(55·0)	66·1	71·4	76·6	(80·2)	82·9	(8
1934	(49·5)	62·5	70·7	74·3	80·0	(82·2)	8
1935	(54·5)	64·4	69·3	77·0	80·3	84·3	(8
1936	—	70·2	72·6	81·3	80·9	84·7	9
1937	(54·5)	(62·2)	74·1	78·0	81·3	84·1	8
1938	53·1	63·9	69·5	77·4	82·5	83·6	8
1939	49·3	58·9	65·8	74·2	79·1	—	(8

Age-Groups. **Northern Districts.**

XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV	XXV	XXVI	
—	—	—	—	—	—	—	—	—	—	—	1924
—	—	—	—	—	—	—	—	—	—	—	1926
—	—	—	—	—	—	—	—	—	—	—	1927
(20·5)	—	—	(113·0)	—	—	—	—	—	—	—	1928
—	—	—	—	—	—	—	—	—	—	—	1929
—	—	(150·5)	—	—	—	—	—	—	—	—	1930
(17·0)	—	—	(121·7)	—	—	—	—	—	—	—	1931
10·8)	119·1	123·1	—	—	—	—	—	—	—	—	1932
05·0	151·5	129·0	—	—	126·1	—	—	—	—	—	1933
01·5)	108·1	(112·5)	(135·6)	—	—	(135·5)	—	—	—	—	1934
02·4	—	107·5	—	118·5	—	—	—	—	—	—	1935
97·1	100·6	(110·5)	113·1	—	—	(128·5)	—	(133·5)	—	—	1936
02·1)	105·4	103·0	—	114·5	—	—	—	—	—	—	1937
00·6	91·5	108·5	(100·6)	97·5	(114·5)	—	—	—	—	—	1938
01·8	99·5	104·5	—	(108·5)	—	(116·5)	—	—	—	—	1939

Southern Districts.

XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV	XXV	XXVI	
—	(117·5)	(132·5)	(129·5)	—	—	—	—	—	—	—	1927
—	—	—	—	—	(153·5)	—	—	—	—	—	1929
—	—	(124·8)	—	—	—	—	—	—	—	—	1930
—	—	—	—	—	—	—	—	—	—	—	1931
104·5)	(115·3)	(132·5)	—	(127·0)	—	—	—	—	—	—	1932
109·8	(123·5)	—	—	—	(114·5)	—	—	—	—	—	1933
—	122·4	(118·5)	—	—	—	(136·5)	—	—	—	—	1934
108·0)	—	(128·5)	—	—	—	—	—	—	—	—	1935
100·5)	(93·5)	—	(135·6)	—	—	—	—	(134·5)	—	—	1936
—	(98·5)	—	—	(143·5)	—	—	—	—	—	—	1937
96·0	—	—	(122·2)	—	105·8	—	—	—	—	(110·5)	1938
—	100·2	—	—	(108·5)	—	(114·3)	—	—	—	—	1939

Offshore Banks.

XIII	XIV	XV	XVI	XVII	XVIII	
—	—	(102·5)	—	—	—	1924
101·4	—	—	110·8	—	—	1925
—	—	—	—	—	—	1928
108·3	—	—	—	—	—	1930
(106·0)	(106·8)	—	—	—	—	1931
100·9	(98·5)	115·1	99·0	102·5	—	1932
(90·8)	(95·5)	—	(107·5)	—	—	1933
(94·0)	(96·9)	—	—	—	—	1934
95·0	—	—	99·0	—	(91·0)	1935
—	92·8	—	—	(92·2)	—	1936
92·1	(95·5)	96·3	—	—	—	1937
—	90·0	—	(98·7)	—	—	1938
(91·6)	—	—	—	—	—	1939

Table 20.
Average Size of individual Year-Classes.
(Numbers less than ten in brackets.)

	1936			1935			1934			1933			
	B	N	S	B	N	S	B	N	S	B	N	S	
I	—	12·7	—	—	12·4	—	—	11·3	—	—	15·1	16·9	I
II	—	22·4	23·5	—	23·6	27·5	—	24·2	—	—	25·3	—	II
III	—	38·0	37·4	—	35·8	39·8	—	44·1	41·5	—	40·4	40·4	III
IV	—	—	—	49·3	47·4	48·3	53·1	52·7	53·1	(54·5)	54·9	52·7	IV
V	—	—	—	—	—	—	58·9	60·2	60·0	63·9	63·1	59·9	V
VI	—	—	—	—	—	—	—	—	—	65·8	66·9	66·0	VI
		1932			**1931**			**1930**			**1929**		
I	—	14·4	13·9	—	13·6	13·6	—	—	—	—	—	13·1	I
II	—	25·1	26·3	—	24·8	—	—	—	24·2	—	33·3	—	II
III	—	43·6	36·2	—	41·0	35·5	—	43·1	—	—	—	33·2	III
IV	—	53·5	51·9	(54·5)	53·2	46·0	49·5	51·6	43·2	(55·0)	53·5	41·5	IV
V	62·2	63·4	61·9	70·2	64·2	62·4	64·4	60·5	57·6	62·5	62·1	53·4	V
VI	69·5	67·9	68·5	74·1	71·1	70·6	79·6	70·6	68·6	69·3	69·2	66·2	VI
VII	74·2	70·9	72·4	77·4	74·5	75·8	78·0	76·6	75·6	81·3	73·3	75·1	VII
VIII	—	—	—	79·1	77·8	78·5	82·5	79·5	80·3	81·3	80·6	81·7	VIII
IX	—	—	—	—	—	—	—	83·0	81·6	83·6	81·0	82·5	IX
X	—	—	—	—	—	—	—	—	—	(84·8)	83·5	85·9	X
		1928			**1927**			**1926**			**1925**		
I	—	—	—	—	—	—	—	16·7	—	—	—	—	I
II	—	—	—	—	—	—	—	—	—	—	—	—	II
III	—	—	—	—	—	—	—	—	36·6	—	—	—	III
IV	(56·7)	56·2	(58·5)	(57·0)	57·8	—	62·4	56·8	50·4	—	(58·0)	50·1	IV
V	66·1	62·0	(60·5)	66·3	67·9	(59·5)	65·9	67·4	58·2	—	(66·8)	59·8	V
VI	70·7	70·4	61·2	71·4	68·6	66·3	71·9	71·3	64·4	(70·0)	71·3	—	VI
VII	77·0	73·6	71·8	74·3	75·0	66·3	76·6	74·1	70·4	(77·5)	(78·8)	68·3	VII
VIII	80·9	79·1	79·6	80·3	79·0	73·6	80·0	79·1	72·1	(80·2)	75·3	(75·3)	VIII
IX	84·1	83·8	81·8	84·7	83·5	79·8	84·3	83·2	78·7	82·2	82·3	73·0	IX
X	84·1	85·6	(84·5)	85·0	85·6	84·6	90·3	85·0	83·8	87·9	84·1	(79·3)	X
XI	(82·8)	85·1	(86·8)	85·3	85·8	83·8	87·2	88·3	86·5	—	88·3	(88·1)	XI
XII	—	—	—	(92·5)	88·0	91·4	87·6	90·4	89·5	97·0	(89·8)	(82·8)	XII
XIII	—	—	—	—	—	—	91·6	90·1	90·6	—	(88·0)	(93·5)	XIII
XIV											(81·0)		XIV

I	—	—	—	—	—	—	—	—	—	—	—	—	I
II	—	25·0	—	—	—	—	—	34·1	—	—	—	—	II
III	—	38·8	—	—	39·5	—	—	39·5	—	—	43·9	—	III
IV	—	60·0	—	—	(54·8)	—	—	52·8	—	—	—	—	IV
V	—	63·3	55·0	(71·5)	(65·7)	—	—	66·6	66·0	—	66·4	—	V
VI	74·2	67·9	61·8	—	(66·5)	(66·5)	78·0	75·4	—	—	(81·0)	75·1	VI
VII	76·0	75·5	69·4	—	(74·0)	68·8	—	74·9	73·4	—	83·1	—	VII
VIII	82·6	80·7	72·6	85·4	83·5	76·8	87·9	84·9	77·7	—	(75·0)	83·2	VIII
IX	82·9	83·1	79·8	85·0	91·2	78·1	87·7	90·3	85·9	(93.8)	(96·3)	91·4	IX
X	86·3	86·7	78·2	(85·5)	85·5	(78·0)	91·8	93·0	85·3	(86·1)	97·9	102·5	X
XI	89·7	89·6	82·8	(84·3)	89·5	80·8	93·0	93·0	87·8	93·1	(96·5)	(95·5)	XI
XII	92·5	91·3	86·5	89·8	93·9	—	92·9	93·7	83·0	(94·0)	102·2	86·5	XII
XIII	92·1	92·1	89·8	—	95·0	(106·5)	95·0	95·7	86·7	(94·0)	97·2	79·5	XIII
XIV	90·0	92·8	87·8	(95·5)	95·0	—	92·8	96·8	88·7	—	100·8	—	XIV
XV	—	92·7	93·4	—	95·5	—	96·3	99·3	92·4	—	98·7	—	XV
XVI	—	—	—	—	(101·8)	—	98·7	100·6	96·0	—	(102·1)	—	XVI
XVII	—	—	—	—	—	—	—	99·5	100·2	—	91·5	—	XVII
XVIII	—	—	—	—	—	—	—	—	—	—	(104·5)	—	XVIII

	1920			**1919**			**1918**			**1917**			
I	—	—	—	—	—	—	—	—	—	—	—	—	I
II	—	—	—	—	—	—	—	—	—	—	—	—	II
III	—	—	—	—	—	—	—	—	—	—	—	—	III
IV	—	—	—	—	—	—	—	—	—	—	—	—	IV
V	—	—	—	—	66·8	—	—	—	—	—	—	—	V
VI	—	77·8	—	—	—	—	—	(68·0)	—	—	—	—	VI
VII	—	(78·5)	(81·5)	—	(81·8)	—	—	—	—	(85·8)	79·2	—	VII
VIII	(86·8)	(83·0)	—	—	(84·5)	(88·5)	—	(85·5)	—	82·1	—	—	VIII
IX	—	(85·2)	(91·8)	(93·8)	(86·6)	—	—	(71·5)	(92·8)	—	(91·9)	—	IX
X	—	(95·5)	(93·8)	—	(84·5)	(87·2)	—	—	(95·5)	—	95·1	95·9	X
XI	—	101·4	—	—	(96·5)	(98·8)	—	(100·8)	99·3	98·5	97·8	—	XI
XII	94·0	102·1	(106·9)	(100·5)	101·4	—	—	(111·5)	—	—	—	100·6	XII
XIII	(90·8)	94·5	—	100·9	102·7	(83·5)	(106·0)	(104·2)	—	107·6	102·7	106·3	XIII
XIV	(96·9)	100·8	(113·5)	(95·5)	98·0	103·3	(98·5)	(103·1)	—	(106·8)	108·0	—	XIV
XV	—	97·8	—	—	100·3	(99·0)	—	—	—	115·1	108·2	115·8	XV
XVI	—	97·1	(100·5)	98·8	102·4	(108·0)	—	(101·5)	—	(107·5)	105·0	109·8	XVI
XVII	—	105·4	(98·5)	(92·2)	100·6	93·5	—	—	—	—	108·1	122·4	XVII
XVIII	—	(108·5)	—	—	103·0	—	—	(110·5)	—	(91·0)	107·5	(128·5)	XVIII
XIX	—	—	—	—	100·6	(122·2)	—	—	—	—	113·1	(135·6)	XIX
XX	—	—	—	—	108·5	(108·5)	—	97·5	—	—	114·5	(143·5)	XX
XXI	—	—	—	—	—	—	—	—	—	—	(114·5)	105·8	XXI
XXII	—	—	—	—	—	—	—	—	—	—	(116·5)	114·3	XXII

Table 21.

Age Determinations of Recaptured Cod.

Recaptures from Greenland.

Year-class	Year of recapture															
	1926	27	28	29	30	31	32	33	34	35	36	37	38	39	40	Total
1912	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
1915	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
1916	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
1917	—	1	1	—	—	—	—	—	1	—	—	—	—	—	—	3
1918	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1919	—	—	—	—	—	1	—	—	1	1	1	—	—	—	—	4
1920	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	3
1921	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1922	—	—	—	—	—	—	1	—	5	5	8	9	5	7	—	40
1923	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	2
1924	—	—	—	—	—	—	—	1	8	3	8	4	4	6	—	34
1925	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	2
1926	—	—	—	—	—	—	—	—	2	11	8	5	7	9	—	42
1927	—	—	—	—	—	—	—	—	—	—	6	6	1	4	—	17
1928	—	—	—	—	—	—	—	—	1	1	1	3	5	1	—	12
1929	—	—	—	—	—	—	—	—	—	—	—	1	4	3	—	8
1930	—	—	—	—	—	—	—	—	—	—	1	1	1	4	—	7
1931	—	—	—	—	—	—	—	—	—	—	—	3	2	6	—	11
1932	—	—	—	—	—	—	—	—	—	—	—	3	2	7	—	12
1933	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1
Total age-determined	1	1	2	—	—	1	1	1	18	25	36	36	31	48	—	201
Total recaptured	16	16	6	9	16	32	43	23	48	58	44	50	47	62	1	471[1])

[1]) + 1 recaptured 1924 and 15 in 1925.

Recaptures from Iceland.

Year-Class	Year of recapture										
	1930	31	32	33	34	35	36	37	38	39	Total
1915	—	—	—	—	—	1	—	—	—	—	1
1919	—	—	1	—	—	—	—	—	—	—	1
1920	—	—	—	—	—	1	—	—	—	—	1
1921	—	—	—	—	—	—	—	—	—	—	—
1922	1	17	8	18	9	7	—	2	—	—	62
1923	—	1	—	—	—	—	—	—	—	—	1
1924	—	1	3	13	18	9	7	—	—	—	51
1925	—	—	—	—	1	—	—	—	—	—	1
1926	—	—	2	—	4	3	2	2	2	—	15
1927	—	—	—	—	—	—	—	—	—	—	—
1928	—	—	—	—	—	1	—	—	—	1	2
1929	—	—	—	—	—	—	—	—	6	4	10
1930	—	—	—	—	—	—	—	—	—	3	3
1931	—	—	—	—	—	—	—	—	9	27	36
1932	—	—	—	—	—	—	—	—	1	5	6
Total age-determined	1	19	14	31	32	22	9	4	18	40	190
Total recaptured	7	47	35	57	55	45	13	5	40	66	370[1])

[1]) + 1 recaptured 1927.

Uvak (*Gadus ogac*).

This small codfish occurs in West Greenland ars from Cape Farewell to Upernavik in coastal rs and in the fjords, in shallow waters as well t considerable depths. It is not present on the hore banks. It has no importance for the com- cial fishery, but especially in North Greenland caught for local consumption.

In Table 22 a survey is given of the age com- tion in percentages with regard to different hes from the years 1934 to 1939. Otoliths have n used for age determination.

The catch from Holsteinsborg in 1934 is by d-line, the catch from Lichtenau by eel-seine. two catches from Umanak are made by hand- es, long-lines and eel-seine; the three catches m Julianehaab district are mainly from the htenaufjord and secured by long-lines at depths 150 to 300 m.

From Table 22 it will be seen that a number of y ten age-groups has been found in the catches ause the *gadus ogac* do not reach as high an e as the cod. The highest age recorded has been ven years. Certain fluctuations of the year-classes e present, but they are not so pronounced as in stock of cod. It seems that mainly the same ar-classes predominate as in the stock of cod, ., 1926 (?), 1929, 1931 and 1932 year-class, ecially the 1931 year-class has been good.

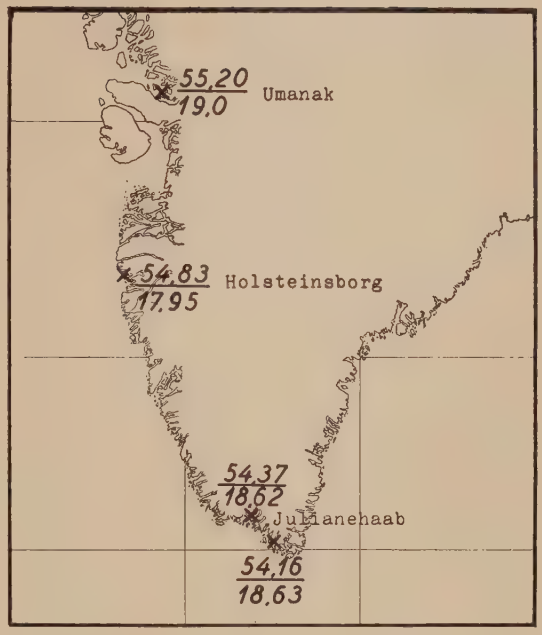


Fig. 25. Gadus ogac. $\frac{\text{Vert.}}{D_2}$

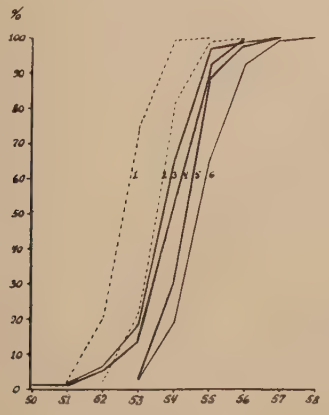


Fig. 26a.
Number of Vertebrae in Cod (dotted line) and *Gadus ogac*.
Summation Curves.

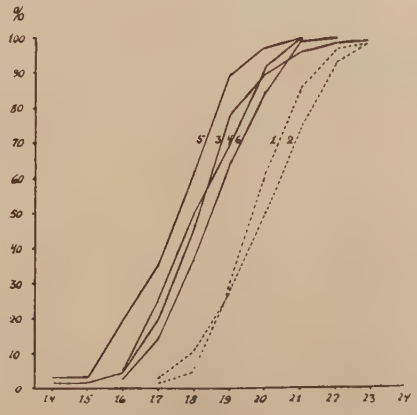


Fig. 26b.
Number of Rays in D_2 in Cod (dotted line) and *Gadus ogac*.
Summation Curves.

1 Julianehaab
2 & 5 Holsteinsborg
3 Lichtenaufjord } Julianehaab
4 Narssak } Distr.
6 Umanak

Table 22.

Age Composition in Percentages, *Gadus ogac*.

Locality	Dstr.	Date and year	II	III	IV	V	VI	VII	VIII	IX	X	XI	No. analysed
Holsteinsborg 66°55′N. 53°37′W.	Holsteinsborg	May 1934	—	1·5	13·4	34·3	22·4	9·0	10·4	3·0	6·0	—	67
Lichtenau 60°29′N. 45°34′W.	Julianehaab	17/8 1934	61·7	36·2	2·1	—	—	—	—	—	—	—	47
Umanakfjord Between 70°30′N. and 70°50′N.	Umanak	2/9 1935	—	1·5	74·2	8·9	12·9	1·5	1·0	—	—	—	202
Umanakfjord and 51° and 52°W.	Umanak	July 1936	—	1·2	7·1	48·7	7·1	19·4	6·5	8·2	1·8	—	176
Between 60° and	Julianehaab	Aug.—Sept. 1937	4·6	5·0	8·6	21·8	25·4	2·3	20·8	2·0	2·6	6·9	303
												1926	
61°N. and	Julianehaab	Aug.—Sept. 1938	—	—	1·5	17·4	14·5	34·8	4·3	26·0	1·5	—	69
45° and 47°W.	Julianehaab	Aug.—Sept. 1939	—	—	2·6	25·0	25·6	27·0	14·5	3·9	1·3	—	152
									1932	1931		1929	1016

Table 23.

Average Size of Different Age-Groups.

Locality	Dstr.	Date and year	II	III	IV	V	VI	VII	VIII	IX	X	XI
Holsteinsborg 66°55′N. 53°37′W.	Holsteinsborg	May 1934	—	(20·0)	(37·0)	42·3	46·8	(44·7)	(52·0)	(56·0)	(51·5)	—
Lichtenau 60°29′N. 45°34′W.	Julianehaab	17/8 1934	24·3	29·8	(30·0)	—	—	—	—	—	—	—
Umanakfjord Between 70°30′ and 70°50′N.	Umanak	2/9 1935	—	(33·3)	42·1	47·3	51·6	(56·0)	(54·0)	—	—	—
Umanakfjord and 51° and 52°W.	Umanak	July 1936	(15·2)	(23·0)	34·2	44·9	49·0	54·2	57·3	61·5	(63·7)	—
	Julianehaab	Aug.—Sept. 1937	22·0	28·3	39·0	43·6	47·4	(48·4)	52·6	(53·8)	(54·0)	56·1
	Julianehaab	Aug.—Sept. 1938	—	—	(35·0)	44·8	47·6	52·9	(50·2)	54·6	(55·0)	—
	Julianehaab	Aug.—Sept. 1939	—	—	(45·3)	45·7	50·1	52·3	54·6	(58·8)	(57·5)	—

Table 24.

Length-Frequencies in cm.

I-Group.

Locality	Dstr.	Date and year		7	8	9	10	11	12	13	14	15	16	No.	Average length in cm.
Avigait 62°15′N. 50°W.	Frederikshaab	24/7 1932	No.	—	7	14	19	34	35	13	7	3	1	133	11·3
			%	—	5·3	10·5	14·3	25·5	26·2	9·8	5·3	2·3	0·8	100·0	—
Uvkusigssat 71°03′N. 51°40′W.	Umanak	5/8 1936	No.	1	5	34	69	47	14	1	—	—	—	171	10·2
			%	0·6	2·9	19·9	40·3	27·5	8·2	0·6	—	—	—	100·0	—
Nugssuak 70°40′N. 54°27′W.	Umanak	13/8 1936	No.	4	16	18	23	20	7	1	1	1	—	91	9·8
			%	4·4	17·6	19·8	25·2	22·0	7·7	1·1	1·1	1·1	—	100·0	—

he average-size of different age-groups of the d *ogac* has been given in Tables 23 and 24. he first two years of life the growth is similar at of the cod, but the average lengths of the d age-groups are much lower than for the cor- nding age-groups of cod. *Gadus ogac* of the d II-groups are often taken in shoals of small f the same age.

Countings of vertebrae and rays in the second dorsal fin are given in Table 25. It will be seen that the mean number of vertebrae are decreasing from north to south. Compared with cod *gadus ogac* has a higher number of vertebrae and a lower number of rays in D_2.

Paul M. Hansen.

Table 25.
Countings of Vertebrae and D_2, *Gadus ogac*.

nnak Fjord, July 1936.
60'N. 51°48'W.

of rt.	No. of fish	%	No. D_2	No. of fish	%
3	1	1·04	22	1	1·04
7	6	6·25	21	14	14·58
6	27	28·13	20	20	20·83
5	43	44·79	19	26	27·08
4	16	16·67	18	21	21·88
3	2	2·08	17	12	12·50
2	1	1·04	16	2	2·08
	96	100·00		96	99·99

Average: 55·20 Average: 19·0

Narssak (Julianehaab Dstr.).
60°54'N. 46°05'W.

No. of Vert.	No. of fish	%	No. D_2	No. of fish	%
56	9	8·26	21	8	7·69
55	43	39·45	20	22	21·15
54	43	39·45	19	21	20·19
53	9	8·26	18	28	26·92
52	4	3·67	17	20	19·23
51	—	—	16	5	4·81
50	1	0·92			
	109	100·01		104	99·99

Average: 54·37 Average: 18·57

steinsborg, May 1934.
55'N. 53°37'W.

o. of ert.	No. of fish	%	No. D_2	No. of fish	%
57	1	2·50	21	1	2·56
56	4	10·00	20	3	7·69
55	23	57·50	19	11	28·21
54	11	27·50	18	11	28·21
53	1	2·50	17	6	15·38
			16	6	15·38
			15	—	—
			14	1	2·56
	40	100·00		39	99·99

Average: 54·83 Average: 17·95

Lichtenaufjord.
60°31'N. 45°33'W.

No. of Vert.	No. of fish	%	No. D_2	No. of fish	%
57	1	0·99	23	1	1·01
56	3	2·97	22	2	2·02
55	33	32·67	21	6	6·06
54	45	44·55	20	13	13·13
53	13	12·87	19	32	32·32
52	5	4·95	18	24	24·24
51	1	0·99	17	17	17·17
			16	3	3·03
			15	—	—
			14	1	1·01
	101	99·99		99	99·99

Average: 54·16 Average: 18·63

Halibut.

The age compositions in percentages from catches in 1935 to 1938 are given in Table 26. The age determinations are based on otoliths. The samples from 1935 and 1936 are from commercial catches at Holsteinsborg and Kangamiut (Sukkertoppen district), the samples from 1937 and 1938 have been collected at Kangamiut. No samples of otoliths of halibut have been collected in 1939. It is obvious that there is some agreement between t species and the stock of cod as to good and p year-classes.

In Tab. 27, in which the average sizes of differ age-groups are given, the material from Kangam in 1935 is excluded owing to uncertain leng measurements. Average lengths from material than 10 specimens are recorded in brackets.

Paul M. Hansen

Table 26.
Age Composition in P

Catch from Year	Total No. of Fish	Age-Groups IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI
1935	147	—	—	3·4	7·5	11·6	21·0	4·1	20·3	2·0	12·9	1·4	0·7	2·7
1936	378	—	2·1	5·8	9·0	17·7	9·8	24·5	4·0	12·2	0·8	6·3	0·3	0·5
1937	389	0·3	0·3	6·4	2·1	20·0	4·4	6·2	36·5	0·5	10·6	0·5	9·0	—
1938	279	0·4	1·4	4·3	11·1	4·0	24·7	6·1	2·1	27·2	0·4	9·7	—	5·8
	1193					**1931**		**1929**			**1926**		**1924**	

Table 27.
Average Size of Differen

Locality	District	Year	V	VI	VII	VIII	IX	X	XI	XII	XIII	
Holsteinsborg 66°55′N. 53°37′W.	Holsteinsborg	1935	—	(67·3)	(73·1)	74·8	74·6	(86·7)	(87·8)	—	—	
,,	,,	1936	—	(67·3)	76·4	79·8	(81·0)	86·3	(92·0)	100·8	—	
Kangamiut 65°49′N. 53°15′W.	Sukkertoppen	1936	(66·0)	71·6	75·4	80·7	82·9	86·5	92·5	98·0	(112·0)	
,,	,,	1937	—	68·4	(71·8)	79·3	81·7	88·9	91·6	(93·5)	103·2	(
,,	,,	1938	63·3	64·5	70·9	73·6	82·4	88·8	(80·2)	95·5	—	

rcentages.

XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV	XXV	XXVI	XXVII	XXVIII	
1·4	4·1	—	1·4	0·7	3·4	1·4	—	—	—	—	—	1935
0·3	—	3·7	0·3	—	1·3	—	0·3	0·3	0·5	0·3	—	1936
0·3	0·5	—	1·8	—	0·5	—	—	—	—	—	0·3	1937
—	—	1·4	—	0·7	—	0·7	—	—	—	—	—	1938
1922					**1917**							

Age-Groups.

XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV	XXV	XXVI
—	—	—	—	—	—	—	—	—	—	—	—	—
114·3	—	—	—	—	(134·2)	—	—	(161·3)	—	—	—	(186·0)
111·5	—	—	—	—	176·5	—	—	—	—	—	—	—
108·0)	(118·0)	—	—	(130·0)	—	(165·4)	—	(165·0)	—	—	—	—
100·6	—	123·7	—	—	(127·5)	—	(141·5)	—	(175·0)	—	—	—

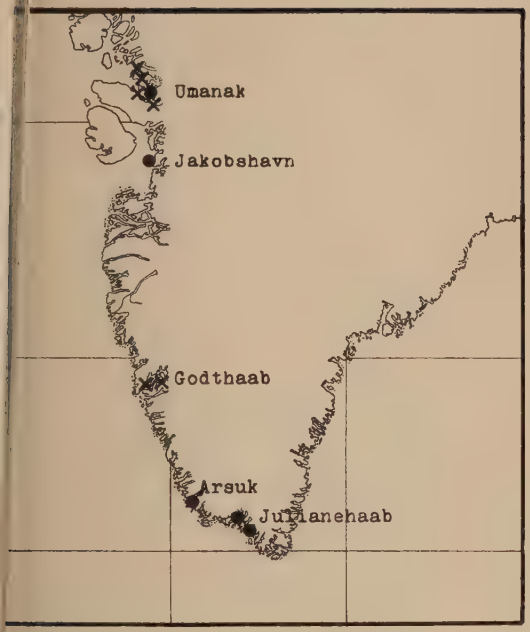


Fig. 27. Marking Experiments with Greenland Halibut.
● recaptures obtained (see Table 28).
× no recaptures obtained.

Greenland Halibut (*Rheinhardtius hippoglossoides*).

Since 1935, marking experiments on Greenland halibut have been undertaken each year at different localities in West Greenland waters. A list of these experiments is given in Table 29.

The Greenland halibut used for marking have always been taken at depths of about 200 to 500 m. with long-lines, only kept two to three hours in the sea. The fish was marked immediately after capture and all fish badly wounded by the hook were excluded. The marks used were of the same sort as those used in cod-marking experiments, they were fixed with silver wire in the gill-cover on the eye-side of the fish by means of the marking-needle described by Tåning. The length of the fish and other necessary details were taken (locality, date etc.).

A total of 1090 Greenland halibut have been marked in sixteen experiments. From seven experiments recaptures have been made, in most cases in the neighbourhood of the place where the marking experiment was carried out. Some of the recaptures from the experiments at Jakobshavn, however, originate from the ice-fjord at Jakobshavn some miles away from the place where the fish were marked and liberated. The recaptures from the ice-fjord have all been taken in the spring when fishing takes place at this locality. No long migrations, e. g., from one district to another, have

Table 28.
Marking Experiments. Number of Recaptures.

Marking year	No. marked		Recaptures 1935	1936	1937	1938	1939	Total	%
Jakobshavn, 69°11′N. 51°W.									
1935	364	No.	23	41	19	2	2	87	23·9
		%	26·4	47·2	21·8	2·3	2·3	100·0	
1936	76	No.	—	2	13	5	2	22	28·95
		%	—	9·1	59·1	22·7	9·1	100·0	
Ikerassak in Umanakfjord, 70°30′N. 51°05′W.									
1936	21	No.	—	—	2	—	—	2	9·5
		%	—	—	100·0	—	—	100·0	
Arsukfjord, 61°10′N. 48°18′W.									
1937	194	No.	—	—	2	4	—	6	3·09
		%	—	—	33·3	66·7	—	100·0	
Lichtenaufjord, 60°31′N. 45°33′W. and 60°40′N. 45°21′W.									
1937	76	No.	—	—	—	16	3	19	25·0
		%	—	—	—	84·2	15·8	100·0	
1938	28	No.	—	—	—	1	3	4	14·29
		%	—	—	—	25·0	75·0	100·0	
Narssak (Julianehaab Dstr.), 60°54′N. 46°05′W.									
1937	6	No.	—	—	—	1	1	2	33·3
		%	—	—	—	50·0	50·0	100·0	

been recorded. All recaptures have been made by the Greenlanders.

The greatest number of recaptures has been made during the first year after the marking experiment, the number of recaptures decreasing rapidly in following years.

The recaptures are considerably numerous in the experiments at Jakobshavn and in Lichtenaufjord, probably owing to the fact that commer fishing is carried out at these localities. In Godthaabsfjord the natives do not fish for Greenland halibut, in the Umanakfjord it is t only for home consumption and in the Arsukf only very few people participate in the fish which here was commenced but a few years ago

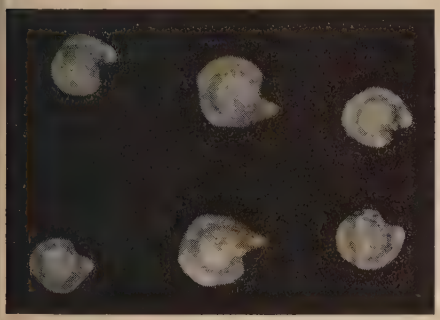
Paul M. Hanse

Table 29.
Marking Experiments, Greenland Halibut.

Locality	Date	Year	Total marked	No.
Kapisigdlit (Godthaabsfjord) 64°23′N. 50°25′W.	30/5	1935	5	1—5
Sardlok (Godthaabsfjord) 64°22′N. 51°38′W.	31/5—4/6	1935	112	6—117
Jakobshavn 69°11′N. 51°W.	22/7—1/8 9/9—14/9	1935 1935	363	118—377 398—500
Ikerassak (Umanakfjord) 70°30′N. 51°05′W.	23/8	1935	20	378—397
Sardlok (Godthaabsfjord)	8/6—13/6	1936	99	501—599
Sermiarssuit (Umanakfjord)	13/7—15/7	1936	35	600—634
Ikerassak (Umanakfjord) 70°30′N. 51°05′W.	17/7—21/7	1936	21	635—655
Lille Karajak (Umanakfjord)	22/7	1936	11	656—666
Satut (Umanakfjord)	24/7—25/7	1936	19	667—685
Uvkusigssat (Umanakfjord)	4/8	1936	1	686
Jakobshavn 69°11′N. 51°W.	19/8—9/9	1936	76	687—700 751—814
Arsukfjord 61°10′N. 48°18′W.	15/7—20/7	1937	194	901—1094
Lichtenaufjord 60°31′N. 45°33′W. 60°40′N. 45°21′W.	15/8—21/8	1937	76	1095—1150 815—833
Narssak (Julianeh. Dstr.) 60°54′N. 46°05′W.	13/9—15/9	1937	6	834—839
Lichtenaufjord 60°31′N. 45°33′W. 60°40′N. 45°21′W.	12/8—16/8	1938	28	840—868
Lichtenaufjord 60°40′N. 45°21′W.	5/9—7/9	1939	24	869—892
		Total	1090	

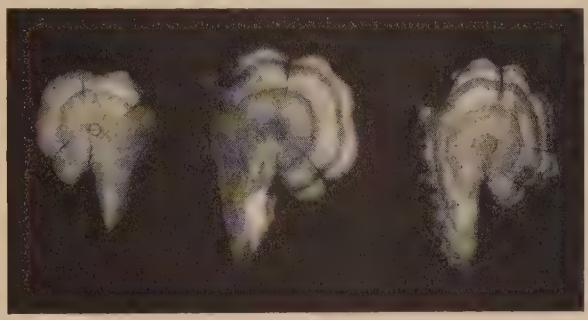
Capelin (*Mallotus villosus*).

In West Greenland waters this small fish has n the object for different investigations owing ts very great importance for the home consump- of the natives and as food for sledge-dogs and ep and moreover as food for some of the portant sea-mammals and fishes as seals, whales, , Greenland halibut etc. In the spring and early mer it enters the tidal zone in huge shoals in er to spawn and is then subject to catch by the enlanders.



P. Holst-Christensen, phot.

Fig. 28a.
I-Group Specimens from August.



P. Hansen, phot.

Fig. 28b.
a) III-Group from June. b) IV-Group from June.
c) V-Group from June.

All the samples of which length-frequencies re given in Table 30 consist of catches from such pawning shoals with the exception of the sample om Tasermiut in 1939, which consists of females ken in stomachs of the char. The occurrence of sidual eggs in the body-cavity of these females owed, however, that spawning had taken place the same year. The samples from Umanakfjord ow higher length-frequencies than the samples om South Greenland.

There is a great difference in the percentages f sexes in each catch of capelin probably owing the fact, that the females are more numerous an the males when the shoals at the beginning of he spawning season come to the shores, and that ey leave the shores immediately when spent; the ales however stay longer because they mature ore slowly.

The otoliths of the capelin form a very good aterial for the determination of age (Fig. 28). he I-group has been taken occasionally by eel-seine lose to the shores. Length-measurements of the -group are given for 812 specimens taken in manakfjord in 1936. The average length was 6·8 mm. The II-group has only been taken in ery small numbers and chiefly in stomachs of cod and other fishes. This age-group is immature and does not enter the spawning shoals in which the youngest age-group is the III-group. In the spawning shoals, as seen in Table 32, the IV- and V-groups are the most numerous age-groups, especially the IV-group is predominant. The great bulk of capelin spawns probably only once or twice. Only few reach an age of six years.

The average lengths of the age-groups III to IV are shown in Table 32. The females are much smaller than the males. In the samples from Umanakfjord the average lengths of the age-groups are much higher than corresponding age-groups of capelin taken in southern localities.

It is also seen that the average length of the same age-groups may differ at the same locality in different years, as for instance at Kapisigdlit, where the values found in 1939 are much lower than those from 1936. This fact has probably been caused by bad conditions for the growth in the extremely cold year, 1938.

Vertebrae-countings upon capelin are given in Table 33. The numbers of vertebrae are found to be between 68·07 and 68·27. The results show that there are no racial differences between the different shoals of capelin investigated at West Greenland and East Greenland. On the west coast the lowest averages are found in the warmest area, i. e., at Godthaab.

The average numbers of vertebrae of capelin found at Greenland, however, differ considerably from those found in other waters where this fish has been examined. In Icelandic waters for instance F r i d r i k s s o n has found that the average number is 69·48.

Paul M. Hansen.

Table 30.
Length-Frequencies in Percentages, Capelin.

Locality	Date	Year	Sex	10	11	12	13	14	15	16	17	18	19	20	Total No. of Fish	% of sexes in catches
Kapisigdlit			♂♂	—	—	—	2·3	20·9	55·9	18·6	2·3	—	—	—	259	62·1
64°23′N.	25/5	1933	♀♀	—	1·3	17·0	40·5	30·4	10·8	—	—	—	—	—	158	37·9
50°25′W.																
Kapisigdlit			♂♂	—	—	—	—	—	—	—	—	—	—	—	—	2·9
64°23′N.	29/5	1933	♀♀	—	—	3·8	37·9	39·4	17·4	1·5	—	—	—	—	132	97·1
50°25′W.																
Fiskenæs			♂♂	—	—	0·8	13·6	51·7	32·2	1·7	—	—	—	—	118	29·0
63°03′N.	10/6	1933	♀♀	1·0	13·2	45·0	33·8	6·6	0·3	—	—	—	—	—	289	71·0
50°48′W.																
Grædefjord			♂♂	—	0·3	1·0	9·4	47·8	37·7	3·8	—	—	—	—	393	76·5
63°18′N.	12/6	1933	♀♀	—	0·8	15·7	38·0	36·4	8·3	0·8	—	—	—	—	121	23·5
51°10′W.																
Avigait			♂♂	—	—	1·1	4·0	26·9	38·7	24·4	4·8	—	—	—	353	97·8
62°15′N.	30/6	1933	♀♀	—	—	—	—	—	—	—	—	—	—	—	—	2·2
50°00′W.																
Ivigtut			♂♂	—	0·1	2·8	21·5	52·0	20·4	2·5	0·6	—	—	—	711	100·0
61°10′N.	13—14/7	1933														
48°18′W.																
Ikertok			♂♂	—	—	1·1	16·5	45·2	29·8	7·4	—	—	—	—	188	99·5
66°55′N.	2/7	1935	♀♀	—	—	—	—	—	—	—	—	—	—	—	—	0·5
52°30′W.																
Kapisigdlit			♂♂	—	—	—	—	10·5	15·8	44·7	29·0	—	—	—	38	17·7
64°23′N.	28/5	1936	♀♀	—	0·6	3·4	20·4	42·3	29·9	3·4	—	—	—	—	177	82·3
50°25′W.																
Pisigsarfik			♂♂	—	—	—	—	4·3	26·0	44·5	24·0	1·8	—	—	254	96·5
64°24′N.	2/6	1936	♀♀	—	—	—	—	—	—	—	—	—	—	—	—	3·5
50°32′W.																
Bjørneøen			♂♂	—	—	—	0·2	1·7	14·8	50·1	31·0	2·2	—	—	404	94·8
(Godthaabsfjord)																
64°22′N.	12/6	1936	♀♀	—	—	—	22·7	27·3	27·3	22·7	—	—	—	—	22	5·2
51°20′W.																
Umanakfjord			♂♂	—	—	—	—	0·5	3·0	13·0	35·5	38·0	8·0	2·0	200	100·0
70°30′N.	16/7	1936														
51°48′W.																
Umanakfjord			♂♂	—	—	—	—	—	0·8	9·5	23·7	42·3	18·8	4·9	265	100·0
70°30′N.	14/7	1936														
51°48′W.																

Sarfanguak						0·6	8·5	29·2	42·5	18·1	1·1	—			6·9
66°52′N.	21/6	1938	♂♂	—	—	—	—	—	—	—	—	—	—	—	
52°52′W.			♀♀	—	—	—	—	—	—	—	—	—	—		
Kapisigdlit														188	61·0
64°23′N.	17/6	1939	♂♂	—	—	5·3	50·0	42·0	2·7	—	—	—	—	120	39·0
50°25′W.			♀♀	1·7	15·8	45·1	31·6	5·8	—	—	—	—	—		
Tasermiut														—	2·2
60°18′N.	28/8	1939	♂♂	—	—	—	—	—	—	—	—	—	—	88	97·8
44°48′W.			♀♀	5·3	14·7	33·3	25·3	18·7	2·7	—	—	—	—		
Angmagssalik														200	99·5
65°12′N.		1939	♂♂	—	—	—	—	—	3·0	8·5	24·6	34·7	27·1	2·0	0·5
37°05′W.			♀♀	—	—	—	—	—	—	—	—	—	—	—	
														7844	

Table 31.

Length-Measurements of 812 Fish.

I-Group.

Loc.: Umanakfjord. Date and year 23/7 1936.

Size in mm	34	—	—	—	—	—	40	—	—	—	—	45	—	—	—	—	50	—	—	—	—
Length-frequencies in % ...	0·1	0·5	1·4	2·3	2·7	4·2	6·7	6·1	5·9	5·9	6·2	5·8	4·4	4·4	3·8	5·1	5·2	4·9	4·7	3·8	2·7
Size in mm	55	—	—	—	—	60	—	—	—	—	65	—	—	—	—	70					
Length-frequencies in % ...	3·7	1·5	1·7	2·7	1·2	0·7	0·1	0·6	0·2	0·4	0·1	0·1	—	—	—	0·1 : 100·0					

Mean length: 46·8 mm.

Table 32.

Age Composition in Percentages and Average Size of Different Age-Groups in Spawning Shoals.

Locality	District	Date	Year		Age-Composition in percentages III	IV	V	VI	VII	No. examined	Average-Length in cm. III	IV	V	VI
Kapisigdlit	Godthaab	28/5	1936	♂♂	6·7	50·8	37·0	5·5	—	73	(15·3)	16·2	16·1	(16·6)
64°23′N. 50°25′W.				♀♀	7·0	48·0	38·3	6·9	—	256	14·1	14·9	15·1	15·3
Pisigsarfik	Godthaab	2/6	1936	♂♂	12·2	51·2	30·5	6·1	—	82	15·3	15·9	15·5	(15·6)
64°24′N. 50°32′W.														
Grædefjord	Godthaab	12/6	1933	♂♂	13·2	69·4	14·9	1·7	0·8	121	—	—	—	—
63°18′N. 51°10′W.														
Umanakfjord	Umanak	14/7	1936	♂♂	5·4	48·7	44·1	1·8	—	111	(16·3)	17·7	18·3	(18·5)
70°30′N. 51°48′W.														
Kapisigdlit	Godthaab	17/6	1939	♂♂	10·6	55·9	28·2	5·3	—	188	13·0	13·4	13·6	13·6
64°23′N. 50°25′W.				♀♀	22·5	67·5	8·3	1·7	—	120	11·6	12·4	12·5	13·0

Table 33.
Vertebrae Countings.
Capelin.

West Greenland.

Loc.: Kapisigdlit (Godthaab Distr.)
Position: 64°23′N. 50°25′W.
Date and year: 26th May, 1933.

No. of Vert.	No. of Fish	%	Average
70	9	6·3	68·15.
69	34	24·0	
68	60	42·2	
67	36	25·4	
66	3	2·1	
	142	100·0	

Loc.: Pisigsarfik (Godthaab Distr.)
Position: 64°24′N. 50°32′W.
Date and year: 2nd June, 1936.

No. of Vert.	No. of Fish	%	Average
72	1	0·7	68·07.
71	—	—	
70	5	3·4	
69	43	29·0	
68	57	38·5	
67	38	25·7	
66	4	2·7	
	148	100·0	

Loc.: Umanak
Position: 70°30′N. 51°48′W.
Date and year: 14th July, 1936.

No. of Vert.	No. of Fish	%	Average
71	2	1·4	68·25.
70	8	5·7	
69	36	25·7	
68	71	50·8	
67	23	16·4	
	140	100·0	

Loc.: Tasermiut (Julianehaab Distr.)
Position: 60°18′N. 44°48′W.
Date and year: 28th August, 1939.

No. of Vert.	No. of Fish	%	Average
70	6	6·0	68·22
69	32	32·0	
68	43	43·0	
67	16	16·0	
66	3	3·0	
	100	100·0	

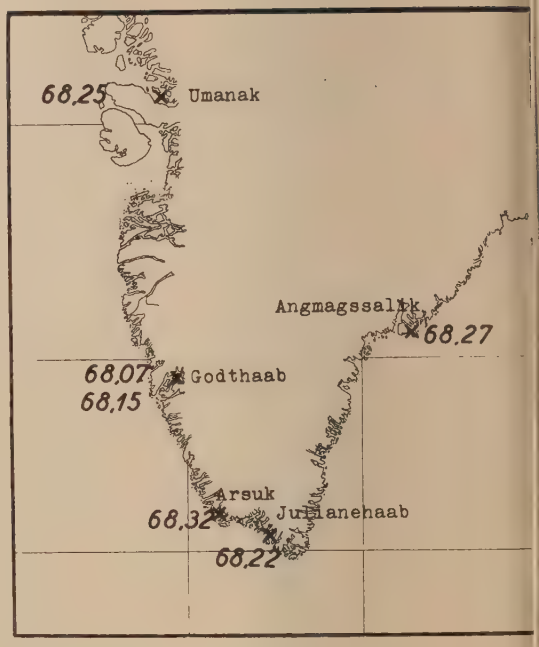


Fig. 29.

East Greenland.

Loc.: Angmagssalik
Position: 65°36′N. 37°30′W.
Date and year: April—May, 1939.

No. of Vert.	No. of Fish	%	Average
71	4	2·4	68·27.
70	12	7·3	
69	47	28·6	
68	70	42·6	
67	26	15·9	
66	3	1·8	
65	2	1·2	
	164	99·8	

Loc.: Arsukfjord
Position: 61°10′N. 48°15′W.
Date and year: 21st July, 1933.

No. of Vert.	No. of Fish	%	Average
70	12	10·0	68·32.
69	36	30·0	
68	50	41·7	
67	22	18·3	
	120	100·0	

Southern North Sea.

Hydrography at the Horns Rev and the Vyl Lightvessels

(From "The Danish Meteorological Institute" and "Kommissionen f. Danm. Fiskeri- og Havunders.-Dept. Hydrographical Laboratory"; — compiled by H. Thomsen).

Speed and Direction of the Current at the Lightvessels Horns Rev and Vyl during 1938—39.

		Horns Rev LV. Residual current. Miles per lunar day.	Direction towards.			Vyl LV. Residual current. Miles per lunar day.	Direction towards.
October	1938	6·8	NNW	October	1938	1·7	NW
November	„	7·4	NNW	November	„	1·5	NW
December	„	4·1	NNW	December	„	1·0	NW
January	1939	4·4	NNW	January	1939	0·8	NW
February	„	3·9	NNW	February	„	2·0	NW
March	„	4·1	NNW	March	„	0·7	NW
April	„	1·1	NNW	April	„	0·5	NW
May	„	0·6	NNW	May	„	(Lightvessel withdrawn).	
June	„	0·9	NNW	June	„	„	
July	„	0·7	NNW	July	„	„	
August	„	1·7	NNW	August	„	0·9	NW
September	„	(Lightvessel withdrawn).		September	„	(Lightvessel withdrawn).	

The speed of the current has been calculated from estimated observations of the current every fourth hour.

Decade-means of te

Meter	October			November			December			January			February			Ma		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1		
0	15·2	14·0	12·3	11·7	11·6	10·4	9·6	7·3	4·0	4·4	4·4	3·8	3·8	4·2	3·8	4·0	3·	
5	15·4	14·0	12·5	11·6	11·6	10·4	9·6	7·5	4·3	4·2	4·4	3·8	3·8	4·2	3·9	4·0	4·	
10	15·5	14·0	12·8	11·8	11·8	10·6	9·6	7·6	4·5	4·4	4·4	4·0	4·0	4·2	4·1	4·1	4·	
15	15·4	14·0	12·8	11·8	11·7	10·6	9·6	7·6	4·6	4·4	4·4	4·3	4·0	4·2	4·0	4·2	4·	
20	15·5	14·2	13·0	11·9	11·8	10·7	9·8	7·8	4·9	4·5	4·5	4·7	4·2	4·4	4·1	4·3	4·	
30	14·0	14·1	13·0	11·9	11·8	10·6	9·8	8·0	5·1	4·6	4·4	4·8	4·2	4·4	4·1	4·3	4·	

Decade-means

Meter	October			November			December			January			February			Ma		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1		
0	32·4	33·1	32·5	33·0	33·2	33·1	33·9	33·7	33·6	34·0	34·6	34·0	34·0	34·1	33·8	33·0	32	
5	32·4	33·1	32·7	33·0	33·2	33·1	34·0	33·8	33·7	34·1	34·6	34·1	34·2	34·2	33·8	33·1	33	
10	32·7	33·2	32·8	33·1	33·3	33·2	34·0	33·9	33·7	34·1	34·6	34·2	34·2	34·2	33·9	33·2	33	
15	32·8	33·2	32·9	33·2	33·4	33·3	34·1	34·1	33·8	34·5	34·8	34·3	34·4	34·3	34·0	33·5	33	
20	32·9	33·3	33·0	33·3	33·4	33·4	34·1	34·2	33·9	34·7	34·8	34·4	34·4	34·4	34·0	33·7	33	
30	32·9	33·4	33·0	33·3	33·4	33·5	34·2	34·3	34·1	34·8	34·8	34·5	34·4	34·5	34·2	33·8	34	

Decade means af te

Meter	October			November			December			January			February			M		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1		
0	15·0	13·4	11·6	11·1	11·0	9·6	8·8	6·5	3·2	3·3	3·4	3·6	3·5	4·1	3·5	3·9	3	
5	15·3	13·5	12·2	11·2	11·3	10·0	9·0	7·5	3·8	3·6	3·1	3·7	3·4	3·8	3·6	3·7	4	
10	15·4	13·6	12·3	11·2	11·3	10·1	9·1	7·5	3·9	3·7	3·2	3·7	3·5	3·8	3·6	3·8	4	
15	15·4	13·8	12·4	11·3	11·3	10·1	9·1	7·5	3·9	3·7	3·2	3·9	3·6	3·8	3·6	3·8	4	
20	15·5	13·8	12·6	11·4	11·3	10·2	9·2	7·6	4·0	3·7	3·2	3·9	3·6	3·8	3·7	3·8	4	
22	15·5	13·8	12·6	11·3	11·3	10·2	9·2	7·6	4·1	3·8	3·2	3·9	3·6	3·8	3·7	3·8	4	

Decade means

Meter	October			November			December			January			February			M		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1		
0	32·3	32·4	32·5	32·6	32·9	32·6	33·3	34·1	33·5	34·0	33·5	33·8	33·5	33·4	32·9	31·8	32	
5	32·3	32·5	32·6	32·6	32·9	32·6	33·4	34·2	33·5	34·0	33·5	33·9	33·7	33·4	32·9	31·9	32	
10	32·3	32·6	32·6	32·8	33·0	32·8	33·5	34·3	33·5	34·1	33·6	34·0	33·8	33·5	32·9	31·9	33	
15	32·4	32·9	32·8	32·9	33·0	32·8	33·6	34·3	33·6	34·1	33·6	34·1	33·8	33·5	32·9	32·3	33	
20	32·5	33·0	32·9	32·9	33·1	32·9	33·7	34·3	33·7	34·2	33·7	34·1	33·9	33·5	33·0	32·4	33	
22	32·5	33·0	33·0	32·9	33·1	32·9	33·7	34·3	33·7	34·3	33·7	34·2	33·9	33·6	33·0	32·4	33	

30/9 1939.

pril		May			June			July			August			September			
2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
5	6·4	7·5	9·4	11·1	12·0	12·7	14·1	15·1	15·3	16·7	17·2	17·5	18·8				0
5	6·3	7·4	9·2	10·6	11·6	12·2	13·9	15·1	15·5	16·7	17·2	17·4	18·7				5
5	6·4	7·5	8·7	9·9	10·0	11·8	13·2	14·9	15·5	16·8	17·2	16·9	17·9	Lightvessel			10
5	6·3	7·3	8·0	8·3	8·3	10·0	11·5	14·2	15·4	16·4	17·0	16·5	16·6	withdrawn.			15
5	6·3	7·2	7·7	7·7	7·3	8·8	10·6	13·5	15·3	16·2	16·8	16·6	16·6				20
5	6·2	7·0	7·5	7·6	7·2	8·6	10·2	12·9	14·4	15·0	16·5	16·4	16·5				30

-30/9 1939.

pril		May			June			July			August			September			
2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
8	32·9	33·5	33·3	32·8	33·3	33·7	33·7	33·0	32·7	32·7	32·8	32·6	32·5				0
9	33·0	33·6	33·5	32·9	33·6	33·8	33·8	33·1	32·8	32·8	32·8	32·7	32·7				5
9	33·0	33·6	33·7	33·3	34·0	33·9	33·9	33·2	32·8	32·8	32·9	32·9	33·0	Lightvessel			10
1	33·1	33·7	33·8	33·6	34·4	34·2	34·1	33·2	32·8	32·8	32·9	33·2	33·2	withdrawn.			15
2	33·4	33·8	34·0	33·9	34·4	34·4	34·2	33·3	32·8	32·9	33·1	33·2	33·5				20
3	33·5	33·9	34·0	34·1	34·5	34·5	34·3	33·4	32·8	33·0	33·2	33·5	33·6				30

—30/9 1939.

ril		May			June			July			August			September			
2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
·7	6·8	7·8								17·2	17·6	18·0	19·3				0
·3	6·7	7·6								17·1	17·6	18·0	19·1				5
·2	6·6	7·5			Lightvessel withdrawn.					17·0	17·6	17·8	18·3	Lightvessel			10
·1	6·6	7·1								17·1	17·7	17·8	18·0	withdrawn.			15
·2	6·6	7·0								17·0	17·5	17·6	17·8				20
·2	6·5	7·1								17·0	17·4	17·5	17·6				22

—30/9 1939.

pril		May			June			July			August			September			
2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
2·5	32·3	32·8								32·9	32·7	32·7	32·9				0
2·6	32·4	32·9								32·9	32·7	32·7	32·9				5
2·6	32·4	33·0			Lightvessel withdrawn.					33·0	32·7	32·9	32·9	Lightvessel			10
2·8	32·5	33·3								33·0	32·7	32·9	32·9	withdrawn.			15
2·9	32·5	33·3								33·1	32·8	32·9	33·0				20
2·9	32·5	33·4								33·1	32·8	32·9	33·0				22

The Plaice in the Eastern Part of the North Sea.

By

Aage J. C. Jensen.

A. Age- and Length-Distribution.

THE great strength of the year-class 1928, as compared with those of the following years, is clearly seen from the strong representation of the VI-group in 1934. The enormous decrease during the following years in the strength of the age-groups older than the IV-group must be explained partly by the depletion of the stock due to the fishery (see below section C) and partly by the fact that the year-classes 1929—34 have been relatively poor.

In the southern region, however, in 1937—39, the strength of each of the age-groups I, and III, originating from the year-classes 1935—3 has been 50—100 % greater than that of t corresponding age-groups during 1934—36, owi to the fact that the year-classes 1935—38 ha been stronger than the previous ones. It should remarked that in 1936, the year-class 1935, I-group, was found in great numbers only in t northern region. An immigration to the southe region from the north or possibly from the sou must have taken place between the dates of t investigations in 1936 and in 1937.

In the northern region the year-class

Table 1.

Horns Reef Area. Catch per hour in a 50-feet Otter-Trawl with fine-meshed Cod-En

(From: Komm. Danmarks Fiskeri- og Havunders., Dept. Dr. H. Blegvad.)

Year	Month	Depth-Zone m.	No. of Stations	Age-Groups 0	I	II	III	IV	V	VI	VII	VIII	Size-Groups, cm. 4— 9	10— 14	15— 19	20— 24	25— 29	30— 34	35— 39
a. Southern Region (55°00′ — 55°33′ N. Lat.).																			
1939	VII	10—20	7	407	448	361	101	2	—	—	—	0·3	408	538	314	56	3	0·3	—
		20—30	7	0·3	13	168	98	14	0·6	—	—	—	2	49	169	62	11	2	—
		30—40	1	—	—	—	—	6	4	—	—	—	—	—	—	—	6	4	—
1934	VI	10—30	14	—	103	62	46	40	46	79	1	—	54	68	84	133	46	2	0·3
1935	VI	„	14	—	95	97	26	13	7	5	8	—	77	88	42	34	11	—	—
1936	VI	„	13	—	79	80	31	5	2	—	1	—	94	56	59	11	4	1	—
1937	VI	„	11	—	135	180	18	1	0·1	—	—	—	107	142	74	10	0·7	—	—
1938	V-VI, VIII	„	14	0·2	151	169	69	9	0·7	—	—	0·2	36	214	113	42	8	0·7	—
1939	VII	„	14	136	160	232	99	10	0·3	—	—	0·3	137	212	217	58	8	2	—
b. Northern Region (55°33′ — 56°00′ N. Lat.).																			
1934	VI	10—20	4	0	132	157	80	64	45	73	0·5	—	90	117	152	158	34	—	—
1936	VI	„	5	0	560	165	22	1	—	—	0·4	—	520	132	46	10	1	—	—
1937	VI	„	4	0	218	169	4	—	—	—	—	—	78	228	80	4	0	—	—
1938	VIII	„	6	3	338	45	4	—	—	—	—	—	6	327	49	7	2	—	—
1939	VII	„	4	141	34	103	16	0·5	—	—	—	—	41	59	83	11	0·5	—	—
1934	VI	20—30	3	0	8	29	38	83	54	144	1	—	2	12	37	213	92	—	—
1936	VI	„	2	0	132	65	22	—	—	—	—	—	97	54	51	16	1	—	—
1939	VII	„	3	0·7	4	29	26	4	—	—	—	—	0·7	12	21	19	11	—	—

and 1937 must obviously have been stronger the year-classes 1936 and 1938.

he strength of the year-class 1939 (the 0-group 39) has been considerably above normal, but the exception of the fishing-experiments from 8, which took place partly during August, no rial for comparison is found in the previous considered in the tables. In June the 0-group never occur in the fishing experiments in any eable numbers.

Table 2.

Nissum Broad. Catch with the "Tog" per 30-min. haul.

(From the Danish Biological Station.)

	Month	Age-Groups 0	I	II	III	IV	V	VI	Total
34	IV	0	27	81	28	8	0·3	1	145
35	V	0	26	88	10	1	0	0	125
36	V	0	152	121	18	0	0	0	291
37	VII	0	243	168	11	0	0	0	412
38	VI	0	197	121	10	0·4	0	0	318
39	VI	0	13	295	62	0·7	0	0	371
33	IX	1	57	83	47	28	8	1	225
34	IX	31	225	47	13	1	0	0	317
35	IX	76	132	61	14	0	0	0	283
36	IX	55	222	81	4	0	0	0	362
37	IX	64	166	72	1	0	0	0	303
38	IX	0	75	43	1	0	0	0	119

In 1934, more older plaice were found than in following years (cp. Tab. 2) as was also the se in the Horns Reef area. The frequency of the ar-classes in the Nissum Broad varies from year year mostly as in the adjacent parts of the North a, but divergences may arise due partly to the riation from year to year in the amount of fry plaice which the current has carried in from the orth Sea, partly to the varying extent of the anderings between the Nissum broad, the North a and the inner broads of the Limfjord. Thus, e year-class 1937 is frequent in the broad though in the adjacent parts of the North Sea coast it has been poor (cp. below Tab. 3). As a result of the wanderings the number of a certain year-class caught per hour in the fjord in the autumn often differs from the number of the same year-class found in the preceding or in the following spring. Generally, only a few plaice of the IV-group or older ones are found in the fjord, since the plaice leave the fjord previous to this age.

B. Coastal Investigations of the Frequency of the Age-Groups. (Tab. 3.)

The year-class 1937 was very rich except off the North Sea coast S. of Thyborøn, the year-class 1938 was poor and the year-class 1939, in the Skagerak at least, as rich as the year-class 1937. The results of the investigations of Dr. Tåning into the frequency of the youngest age-groups off Esbjerg are given on p. 137.

C. The Decrease in the Stock.

Table 4.

Yearly Numerical Reduction, Southern Horns Reef Area, Depth-Zone 10—30 m.

	II ➤ III-Gr.	III ➤ IV-Gr.
1934/35	58 %	71 %
1935/36	68 %	81 %
1936/37	78 %	97 %
1937/38	62 %	50 %
1938/39	41 %	86 %

The reckless and intensive fishery with small-meshed trawls for small flat-fishes has reduced the stock also of the youngest age-groups, the lengths of which were very much below the Danish size-limit. The enormous reduction seen in the table occurred in plaice of 10—20 cm. length, the commercial value of which is very low. Out of 100 2-year-old plaice in 1936, only 22 were left in

Table 3.

Catch of the 0 and I-Group, taken per hour in Coastal Fishing Experiments with the Johansen Young-Fish-Trawl.

(From the Danish Biological Station.)

Year	Skagerak: Skagen—Hirtshals No. of Stat.	0-gr.	I-gr.	Hirtshals—Bulbjerg No. of Stat.	0-gr.	I-gr.	Bulbjerg—Hanstholm No. of Stat.	0-gr.	I-gr.	North Sea: Hanstholm—Thyborøn No. of Stat.	0-gr.	I-gr.	Nissum Broad No. of Stat.	0-gr.	I-gr.	Thyborøn—Hvide Sande (abt. 56° N. Lat.) No. of Stat.	0-gr.	I-gr.
1936	6	77	23	9	38	21	3	10	38	5	8	6	4	188	96	10	2	2
1937	6	98	2	8	137	41	2	126	6	2	84	30	6	562	99	8	6	0·8
1938	6	10	6	9	7	37	2	4	33	4	1·5	32	6	19	62	0	—	—
1939	5	206	0	10	76	2	3	37	0	6	15	1·3	2	184	22	6	0·7	0

Table 5.
Mean Lengths of the Age-Groups I—IV.

(From: Komm. Danmarks Fiskeri- og Havunders., Dept. Dr. H. Blegvad.)

Depth-Zone	Year	Month	I-gr.	II-gr.	III-gr.	IV-gr.
A. Southern Horns Reef Area.						
Depth-Zone 10—20 m.	1934	VI	10·2	15·7	19·2	21·6
	1935	VI	9·0	13·4	19·1	22·0
	1936	VI	8·7	14·5	18·7	22·3
	1937	VI	11·2	14·6	19·1	(26·5)
	1938	V/VI	9·6	14·6	20·2	(24·9)
	„	VIII	12·2	16·6	21·4	(26·0)
	1939	VII	12·5	16·0	20·2	(23·0)
Depth-Zone 20—30 m.	1934	VI	(15·5)	18·1	19·8	22·8
	1935	VI	9·7	14·3	20·2	22·1
	1936	VI	(10·5)	15·0	18·4	24·7
	1937	VI	—	16·4	21·3	(27·5)
	1938	V/VI	10·5	14·6	19·6	24·6
	„	VIII	14·6	16·9	20·9	(22·5)
	1939	VII	13·2	16·6	20·5	26·8
B. Northern Horns Reef Area.						
Depth-Zone 10—20 m.	1934	VI	9·8	15·3	18·8	22·2
	1939	VII	12·2	16·2	21·0	(20·5)
Depth-Zone 20—30 m.	1934	VI	11·0	16·1	20·4	23·2
	1939	VII	(11·7)	16·7	23·4	(26·8)

Mean-values given in brackets are based upon less than 10 individuals.

1937, when they were 3 years old. During the latest years the conditions seem to have somewhat improved, the number of the year-class 1935 was reduced by 62 % when ageing from the II-group in 1937 to the III-group in 1938. The corresponding reduction for the year-class 1936 from 1938 to 1939 was 41 % only. The figures for the reduction of the number of plaice from the III-group in any year and the next one are rather differing, still the number of plaice of the IV-group found in the years since 1935 has been so low, that the figures found for the reduction during these years are rather doubtful. Otherwise, the figures found for the reduction from the III to the IV-group correspond to those found from the II- to the III-group.

D. The Lengths of Various Age-Groups.

The length of an age-group in a certain depth-zone of the nursery grounds is determined

(a) by the fishery removing especially the larger fishes within the age-group.

(b) by the emigration of the larger fishes fro the nursery-grounds.

(c) by the growth of the fishes.

From Tab. 5 it is seen that in the southe region the length of the year-class 1933 was less th that of the immediately preceding and followi year-classes. This is explained by the fact that t year-class 1933 was the richest of these year-class (see Tab. 1a) and the growth-rate consequently t least.

The average lengths from August 1938, and Ju 1939, cannot be directly compared with the lengt found in June of the other years, early summ being the proper growth season of plaice in t Horns Reef area[1]). Yet it is obvious that t average length in the later years has not be especially small though the density of the stock h increased very much. Partly, this may be due to t diminished reduction of the stock of these ye (see section C), but the great fluctuations in t amount of food may also be the cause (section E).

[1]) Aage J. C. Jensen: Factors determining Apparent and the Real Growth. Rapp. et Proc.-Verb., V No. 108, I, 16, 1938.

Table 6.

The Weight of Fish-Food taken per m.² with the 0.2 m.² Petersen Grab in the Horns Reef Area during the Years 1934—39.

(From: Komm. Danmarks Fiskeri- og Havunders., Dept. Dr. H. Blegvad.)

Depth-Zone and year	Southern Horns Reef weight, g. of a[1]) m.²	1. class	2. class	not-plaice-food	Northern Horns Reef weight, g. of a[1]) m.²	1. class	2. class	not-plaice-food
10—20 m.								
1934	2·8	2·1	2·3	34·0	1·6	4·9	1·8	137·8
1935	—	—	—	—	0·8	6·5	0·0	0·0
1937	3·2	1·3	3·0	0·0	—	—	—	—
1938	7·8	17·6	4·2	97·9	1·2	6·7	0·5	241·5
1939	2·8	46·3	5·5	46·8	1·6	15·7	5·9	14·9
20—30 m.								
1934	2·8	3·9	4·8	176·1	1·2	5·1	5·1	53·6
1937	0·4	1·2	1·5	0·2	—	—	—	—
1938	1·2	11·1	1·1	438·3	0·2	18·5	0·6	50·0
1939	2·8	5·8	6·1	164·0	1·2	4·1	7·6	105·9
30—40 m.								
1934	1·6	7·8	6·7	162·1	—	—	—	—
1937	0·8	9·5	3·5	52·2	—	—	—	—
1938	3·6	4·1	7·7	76·8	—	—	—	—
1939	0·4	3·1	0·0	75·0	—	—	—	—

[1]) a: area covered by the sampling.

Valuations in the Horns Reef Area.

The bottom invertebrates have been grouped in class, 2nd class and not-plaice-food according the principles of Dr. H. Blegvad[2]). The mount of food was small as compared with that und in the Kattegat (cp. H. Blegvad loc. cit.). the years under investigation it was greatest in 38 and 1939. This fact undoubtedly has been vourable to the growth of the plaice during these ars (cp. section D).

. Length-Distribution and Number of Plaice in the Commercial Catches.

Market measurements of plaice in Esbjerg have en carried out regularly since 1933.

Methods. Measurements have been carried ut in 35 months during the years 1933—38. ormally each time samples of plaice have been easured from 6—10 cutters with live plaice and mples of the market categories from a similar umber of cutters with iced plaice. The weight of ach of the samples measured has been noted. For ne months in which market measurements are not ecorded, the length-distribution for each of the narket categories has been calculated by interpolation. By aid of the statistics of the monthly landings of each market category collected by the Fishery Department of the Ministry af Agriculture and Fishery (Fiskeridirektoratet) the length-distribution of the total landings of the live and iced plaice, respectively, has been calculated.

Results of the Investigation. Length of Market Categories (see Tab. 7). During 1939 market measurements have been carried out only in April. The size of the categories I, II, and III has diminished during the years considered. No accordance is found between the change in the size of the market categories and the change in the size composition of the total landings of iced plaice (Tabs. 8 and 11). From a biological point of view the variations in the limits of the various market categories are normally of rather small importance; being due mainly to the commercial conditions they may give a quite wrong picture of the changes in the stock. In general, they ought to be omitted from the "*Annales Biologiques*".

Size Distribution of the Catch (see Tab. 8).

During the years 1933—35 a displacement in the size distribution of the catches from smaller to larger fish has taken place both in the landings of live and iced plaice corresponding to the fact that the year-classes following the very rich year-class 1928 did not contribute to the recruitment of the stock of commercial fish to a sufficient extent so as

[2]) H. Blegvad: Quantitative Investigations of Bottom nvertebrates in the Kattegat with special reference to the laice Food. Rep. Dan. Biol. Stat., XXXVI, 1930.

Table 7.

Mean Length (M) of Market Categories with Quartiles (cm.) of Plaice landed in Esbjerg in April 1939, compared with the Mean Length at the same Season in previous Years.

(From: Komm. Danmarks Fiskeri- og Havunders., Dept. Dr. Å. V. Tåning.)

Year	Month		Live plaice unsorted	Iced plaice, category V	IV	III	II	I	0
1933	April	M	27·4	—	30·6	36·8	40·3	44·1	53·2
1934	May	M	26·8	—	29·6	35·1	38·8	43·6	—
1935	May	M	27·5	26·8	30·2	34·1	38·2	43·6	53·6
1936	May	M	28·3	—	29·6	33·7	37·4	42·8	57·4
1937	April	M	27·0	—	28·7	33·7	38·1	43·7	55·0
1938	March	M	—	—	29·3	33·7	37·7	43·7	54·2
1939	April	M	28·4	—	29·9	33·0	36·9	40·7	50·2
		Q_1	27·2	—	28·7	31·8	35·5	39·3	47·4
		Q_2	29·6	—	31·2	34·2	38·2	42·0	53·1
		n[1])	(642)		(1611)	(1151)	(751)	(52)	(29)

[1]) number of plaice measured.

Table 8.

Length-Distribution of the Total Annual Catch landed in Esbjerg. — Per mille.

(From: Komm. Danmarks Fiskeri- og Havunders., Dept. Dr. Å. V. Tåning.)

	1933	1934	1935	1936	1937	1938
Total Catch.						
21—25	285	200	82	26	86	63
26—30	566	625	637	648	649	561
31—35	95	143	222	250	186	276
36—40	33	22	42	58	48	72
41—45	13	7	11	13	21	19
46—50	16	3	4	3	6	5
51—55	2·1	1·0	1·7	1·3	2	3
56—60	0·6	0·5	0·6	1·2	0·9	2
61—65	0·1	0·02	0·09	0·3	0·3	0·4
66—70	0·2	—	—	0·1	0·03	0·03
Live Plaice, Danish Catches.						
21—25	415	306	149	56	174	114
26—30	563	671	794	855	785	816
31—35	21	22	57	87	40	67
36—40	1	0·5	0	2	0·6	3
41—45	—	—	0·6	—	0·2	0·2
Iced Plaice, Danish Catches.						
21—25	22	4	4	3	7	6
26—30	572	539	455	493	527	280
31—35	245	366	415	371	317	506
36—40	97	60	89	100	91	148
41—45	39	20	23	23	40	39
46—50	17	8	8	5	12	10
51—55	6	3	3	2	4	6
56—60	2	2	1	2	2	4
61—65	0·5	0·1	0·2	0·5	0·6	0·7
66—70	—	—	—	0·1	0·1	0·1

to maintain the same proportion of the small sizes in the stock.

Number of Plaice Landed.

Considering the landings of live plaic (see Tab. 9) the changes from year to ye are the result of the changes caused by many factor viz., (1) the density of the stock, (2) the growt rate, (3) the situation of the fishing ground, (4) t fishing intensity, and (5) the size-limit.

Table 9.

Number of Live Plaice (in '000,000) landed in Esbjerg 1933 – 38.

	21—25 cm.	26—30 cm.	31—35 cm.	All Size
1933	13·4	26·7	4·5	47·1
1934	9·9	31·0	7·1	49·7
1935	2·8	21·5	7·5	33·7
1936	0·7	18·8	7·2	29·0
1937	2·7	19·9	5·7	30·7
1938	1·9	17·5	8·6	31·1

ad (1) If we wish to compare the fluctuatio from year to year in the number of plaice availab (Tab. 1) and the number of plaice caught, we ha to consider not only the number of commerci plaice found at the fishing experiments but al the fluctuations in the number of plaice in the siz group below the lengths caught on account of t fact that part of these plaice will recruit the sto of commercial plaice in the course of the ye The decrease in the density of plaice of the si group 21—25 was more or less of the same si as the decrease in the density of plaice of the si groups 15—19 cm. and 20—24 cm. seen in Tab. the changes in the number of larger plaice caug were quite different.

ad (2) In the growth-rate (cp. section D) t fluctuations seem to have been but rather small.

(3) During 1933 the main part of the live ce were landed from the inner parts of the sery grounds east of 7°E. Long., but during the owing years, on account of the impoverishment the nursery grounds, this fishing was to a con- erable degree displaced to the grounds between and 7° E. Long. This fact contributes to the lanation of the very great fall in the catch of ice of the size-group 21—25 cm. and explains increase in the size-group 31—35 cm.

(4) The only measure of the fishing intensity ailable down to 1936 is the number of "cutter- ys", i.e., the amount of the monthly yield of the mber of cutters fishing (without discriminating ween cutters landing live and iced plaice) mul- lied by the number of days when fishing could carried out ("fishing-days").

For the later years the number of "cutter-days" nnot be calculated but the number of landings r each of the fisheries has been noted.

Table 10.
The Fishing Intensity of the Fishery from Esbjerg.

Year	No. of "Fishing-Days"	"Cutter-Days"	No. of Landings of Live Plaice	No. of Landings of Iced Plaice
1933	269	97253	—	—
1934	241	89311	—	—
1935	220	81174	—	—
1936	223	71052	—	—
1937	244	—	5179	4817
1938	204	—	4740	4063

The change in the number of "fishing days" has been parallel to the change in the catch and to the number of "cutter-days". The number of landings of live plaice was greater in 1937 than in 1938, as were the catches of the size-groups 21—25 cm. and 26—30 cm., yet the catch of all sizes was smaller in 1937 than in 1938.

(5) The Danish minimum length for market plaice was 257 mm. until April 1st, 1934, when it was raised to 260 mm. The Danish minimum length for export plaice caught in the North Sea was 240 mm. (for some winter months as low as 225 mm.[1])) until March 15th, 1934. Since that date special permission has been required for export of plaice below the ordinary Danish minimum length (260 mm.) and given as follows:-

245 mm.	1. June 1934—15. March	1935
„	1. June 1935— 3. Nov.	1935
250 mm.	4. Nov. 1935—31. Dec.	1935
„	1. Febr. 1936—15. March	1936
„	1. Jan. 1937—15. March	1937
„	1. Febr. 1938—15. Febr.	1938

[1]) H. Blegvad: Minimum Total Length and Close Times for Marine Fishes in Danmark except the Faroes. Rapp. et Proc.-Verb., Vol. No. 85, I, p. 35. 1930.

Corresponding to the higher minimum of the years 1936—38 the landings of plaice of the size-group 21—25 cm., i.e., lower than 260 mm. have been rather small; in 1937 they were greater than in 1936 and 1938, corresponding to the extended dispensation from the ordinary Danish minimum.

The minimum for export to England was raised considerably after June 1938, for part of September to 30 cm. even, but on account of the fact that a considerable part of the live plaice were exported to Germany and that the main season for live-plaice landings is during the first half of the year this change had but small effect on the size or number of live plaice landed.

Table 11.
Number of Iced Plaice (in '000,000) landed in Esbjerg 1933—38 from Danish Cutters.

	26—30 cm.	31—35 cm.	36—40 cm.	41—45 cm.	All Sizes
1933	8·9	3·8	1·5	0·6	15·5
1934	9·3	6·3	1·0	0·3	17·2
1935	7·0	6·4	1·4	0·4	15·5
1936	8·2	6·1	1·7	0·4	16·5
1937	8·4	5·1	1·5	0·6	16·0
1938	4·1	7·5	2·2	0·6	14·7

Table 12.
Length-Distribution of the Total Catch landed in Esbjerg (in '000).

(From: Komm. Danmarks Fiskeri- og Havunders., Dept. Dr. Å. V. Tåning.)

Size-groups, cm.	1933	1934	1935	1936	1937	1938
21—25	13417	9928	2755	742	2641	1946
26—30	26652	31008	21453	18753	19900	17454
31—35	4469	7080	7490	7226	5698	8587
36—40	1557	1076	1401	1675	1480	2248
41—45	601	351	372	385	653	579
46—50	260	137	129	86	189	149
51—55	101	52	56	40	62	83
56—60	27	27	21	35	29	57
61—65	7	1	3	8	9	11
66—70	1	—	—	2	1	1
	47092	49660	33680	28952	30662	31115

The number of iced plaice landed in 1938 and their size-distribution was very much influenced by the Danish minimum for plaice exported to England, this limit being raised to 30 cm. during the period September 11th to October 18th, due to the fact that the bulk of the iced plaice is exported to England and that the latter part of the year normally gives the best yield.

During nearly the whole of 1934 the size-limit

for export to England was above the ordinary Danish size-limit, i.e., 265 mm. but in 1935 it was 270 mm. from February 1st to March 25th and was then until October 7th raised to 275 mm.

The influence of these measures is clearly seen in the decrease of the density of the size-group 26—30 cm. in 1935.

Apart from the special conditions of 1938, explained above, the changes in the number of plaice in the size-group 31—35 cm. is easily explained by the influence of the variations in th strength of the year-classes, the rich year-class 192 augmenting the number of this size-group especiall in 1934—36. (See Tab. 12.)

The changes in the total catch are naturally compound of the changes in the landings of li and iced plaice. By weight the landings in Esbjer during 1933—36 constituted about 90 % of th total catch of plaice landed in Denmark from th North Sea, and in 1937—38, 70—75 %.

Fluctuation in the Number of 0-Group Plaice fished in the Waddensea.

By

A. Vedel Tåning.

THE Waddensea (Vadehavet) along the shores of the countries which border the south-eastern North Sea is well known as the most important nursery ground for young North-Sea plice, especially those of the 0-group. Experimental fishing for estimating the strength of the group has been carried out in the Danish part of these waters as far back as 1905, the experiments having however interrupted now and then during the years. In the following a short review is given of previous experiments carried out by A. C. Johansen as well as recent experiments carried out during the period 1933—1941.

It is, however, very difficult to get reliable estimations of the strength of the 0-group plaice in these waters, and this has previously been pointed out *inter alia* by A. Bückmann some years ago[1]). Our recent experiments may probably also show that we have to use other methods for estimating the strength of the year-class in its first year, and experiments aiming at this end are in progress; it is, however, necessary to have some idea of the strength of the various year-classes more or less comparable with the results obtained by various methods in this area and by the same method in other waters, and the uniform course of procedure now used during the fishing may probably give somewhat better results than previously obtained, and rather reliable results seem to have been obtained during the recent years.

In his paper "On the density of the young plaice population etc." (Medd. Kom. Fiskeri, VI, 8, 1922) C. Johansen has given some data concerning previous experiments in the area and gives loc. cit. p. 14 the *average catch per hour of specimens of 0-group plaice in the Ho-bugt—Fanø Waddensea* (young-plaice trawl with a 7-metre foot rope being used):

Year	Average No. per hour
1905	27
1909	105
1910	95
1911	13
1912	284
1920	21
1921	64
1922	433

For the year 1922 the results from Johansen's experimental fishing have been given by A. Fr. Bruun (Medd. Kom. Fiskeri, VIII, 5, 1927, pp. 19 and 27), the average catch being 433 specimens per hour, i.e., the highest number taken in any year in this area. The year-class 1937 has however been of a similar great strength as 0-group in the Waddensea off south-west Jutland as will be seen below.

The average catches from this earlier period however are not fully comparable with the average catches in recent years because the gear employed has been somewhat, though not much, altered during the years and also because the depth where fished has not always been the same as in the recent experiments (1—2·5 m.), some deeper hauls being included; moreover the localities where fished are not the same.

Collection of material of 0-group plaice in the Waddensea off south-west Jutland has been carried out for about ten years. The gear employed has been the Johansen young-plaice trawl, the ground rope being 10 metres (in September 1935 however a

[1]) Über die Jungschollenbevölkerung der deutschen Wattenküste der Nordsee. Ber. deutsch. Wiss. Komm. Meeresf., N. F., VII, 1935, p. 319—327.

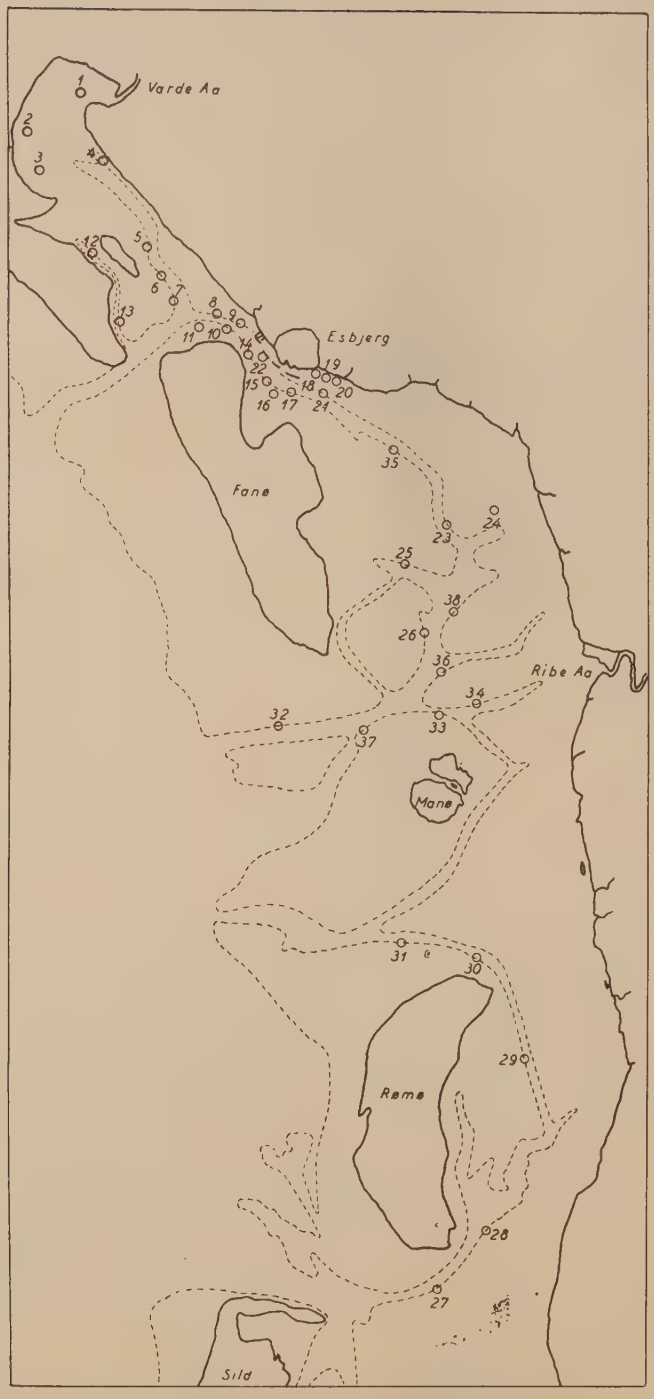


Fig. 1. 0-Group Plaice. Stations in the Danish Waddensea.

Table 1.

Northern Area (St. 1—22)

Year	No. of hauls	No. of spec.	Av. per hour
1933	13	172	53
1934	11	115	42
1935	34*)	1281	151
1936	37	3082	333
1937	26	2701	416
1938	21	373	71
1939	14	1230	351
1940	42	2457	234
1941	18	1558	346
Total	216	12969	240

*) 6 hauls with the ordinary implement (10 m. ground rope), 28 hauls with a smaller implement (7 m. ground rope).

Southern Area (St. 23—39)

	No. of hauls	No. of spec.	Av. per hour
1933	—	—	—
1934	—	—	—
1935	—	—	—
1936	24	1165	194
1937	—	—	—
1938	—	—	—
1939	—	—	—
1940	—	—	—
1941	15	964	171
Total	39	2129	218

Total (St. 1 – 39)

	No. of hauls	No. of spec.	Av. per hour	Deviation from the average
1933	13	172	53	— 184
1934	11	115	42	— 195
1935	34	1281	151	— 86
1936	61	4247	278	+ 41
1937	26	2701	416	+ 179
1938	21	373	71	— 166
1939	14	1230	351	+ 114
1940	42	2457	234	— 3
1941	33	2522	306	+ 69
Total	255	15098	237	

er implement with a 7-metre ground rope). July 1936 lines between the trawl and boards used, these being however disposed of in all hauls. 15 minutes' hauls were carried out, and gear has been operated at a depth of about 5 metres of water, always along the edge of ide channels (all deeper hauls are excluded in review). A few notes on the experiments have iously been given in *Rapports et Procès-Ver-*, Vol. No. 105,2, 1937, p. 42; Vol. No. 107,2, p. 48; and Vol. No. 109, 2, 1939, p. 38.

The whole material has now been re-examined all unsuccessful hauls have been omitted from present review; as not successful hauls we con- such which are taken in too deep water, such, which the implement has not worked properly so on.

In the period here considered stations have been rated in the northern part of the area every year tions 1—22 on the map, Fig. 1); in the southern t of the area however in 1936 and 1941 only

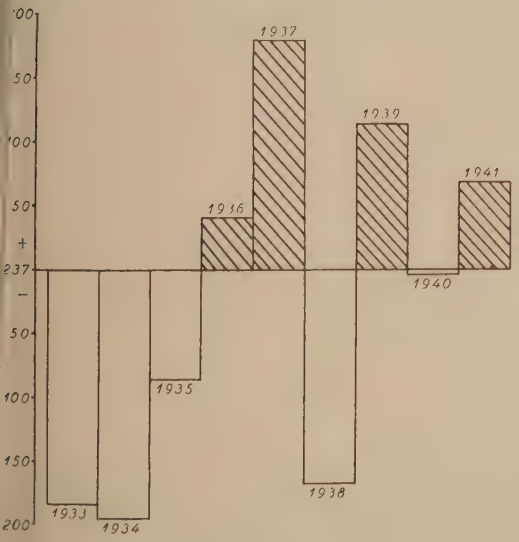


Fig. 2. 0-Group Plaice. Waddensea. Deviations from the Average.

tations 23—39 on the same map). Stations have 1933 and 1934 been operated once only in the ason, in 1935 to 1941 two to four times during e season; it seems to be of importance to carry t the experiments several times during the season *inter alia* because the immigration has proved to be irregular from year to year.

Table 1 is divided in a northern and a southern part owing to the fact, that the southern part has been visited in 1936 and 1941 only. The inclusion in the total of the material from the southern area has however no important influence on the average catch pr. hour in the whole area, though as will be seen the southern area had a lower average than the northern both in 1936 and 1941.

Out of the nine years 4 have had average catches well above the mean (237), viz., 1936, 1937, 1939 and 1941, and one year (1940) is practically = the mean. 4 years, and especially 3 (viz. 1933, 1934 and 1938) are below the mean. 5 out of the last 6 years are normal, good or very good years. The best year-class during the period considered being that of 1937. Fig. 2 shows very clearly the deviations from the average for all years considered.

As far as we know the age-composition of plaice from the open North Sea is in rather good accordance with the facts mentioned; the 1938 year-class seems, however, as adult to have been better than the Waddensea investigations show for this area; it is however possible that the distribution of the brood in this year had its centre more to the south. Unfortunately collections of 0-group plaice do not take place in the more southern areas.

Table 2.
Average Number pr. hour of 0-Group Plaice.

Year	Month of operations					
	June	July	August	Sept.	Oct.	Nov
1933	—	53	—	—	—	—
1934	42	—	—	—	—	—
1935	**204**	—	—	139*)	—	—
1936	143	176	—	**470**	—	102
1937	516	—	—	**763**	111	105
1938	—	—	60	**78**	—	—
1939	—	169	—	—	**453**	—
1940	149	—	—	250	—	**314**
1941	—	—	291	—	**386**	—

*) 28 hauls with a smaller implement (7 m. ground rope).

Table 2 shows that the average number pr. hour generally seems to increase from June—July to September, in some years (1939—41) even later. The few exceptions may be explained *inter alia* by the use of a smaller implement etc.

Der Schollenbestand der Deutschen Bucht.

Von

U. Schmidt,
Biol. Anstalt Helgoland.

Zahlentafel 1.

Absoluter Anteil der einzelnen Altersgruppen am Durchschnittsfang je Stunde im Ma

(Unter dem Durchschnittsfang kursiv das Geburtsjahr).

Altersgruppe:	II	III	IV	V	VI	VII	VIII+	Stück je Stund
Mai 1930	627	174	52	23	2	+	2	881
	1928	*1927*	*1926*	*1925*	*1924*	*1923*	*1922—*	
„ 1933	114	185	220	485	13	1	—	1018
	1931	*1930*	*1929*	*1928*	*1927*	*1926*	*1925—*	
„ 1937	334	230	70	10	3	2	2	651
	1935	*1934*	*1933*	*1932*	*1931*	*1930*	*1929—*	
„ 1938	304	269	56	11	4	1	2	647
	1936	*1935*	*1934*	*1933*	*1932*	*1931*	*1930—*	
„ 1939	220	193	92	12	3	2	2	524
	1937	*1936*	*1935*	*1934*	*1933*	*1932*	*1931*	

Ein zuverlässiger Masstab für die Gesamtdichte des Schollenbestandes ist der Durchschnittsfang je Stunde, der sich aus den wissenschaftlichen Fängen des Forschungsdampfers errechnet. Zahlentafel 1 bringt einen Überblick über den Durchschnittsstundenfang von 1937—39. Zum Vergleich sind noch die Jahre 1930 und 1933 herangezogen, in denen die Verhältnisse durchaus anders lagen und die vor allem den Einfluss eines reichen Jahrganges zeigen. Die Gesamtstückzahl der gefangenen Schollen je Stunde weicht für die Jahre 1937/38 etwas von der in den früheren Berichten veröffentlichten ab (vergl. U. Schmidt, Der Fischmarkt, 1939, Heft 5; hier sind auch die weiteren Literaturangaben zu finden). Dies beruht darauf, dass in der obigen Zahlentafel der Anteil der I-Gruppe nicht berücksichtigt wurde, während der Gesamtfang in den bereits veröffentlichten Berichten sich einschliesslich der I-Gruppe versteht.

Durch die Gegenüberstellung der Jahre 1930 und 1933 einerseits und 1937—39 andererseits treten sehr auffällige Unterschiede in der Dich des Schollenbestandes hervor. In den Jahren 19 und 1933 macht sich der Einfluss des reichen Jah ganges 1928 bemerkbar, der 1930 in der II-Grup mit einem sehr hohen Anteil am Stundenfang er malig in Erscheinung tritt. 1933 stellt er in d V-Gruppe den Hauptanteil des Bestandes. Infol seiner grossen Volksstärke ist die Gesamtdichte d Schollenbestandes in diesen Jahren hoch.

Für die Jahre 1937—39 ist hingegen das Vo herrschen der jungen Altersgruppen II und I charakteristisch, während die älteren Gruppen n unbedeutend an der Alterszusammensetzung d Bestandes beteiligt sind. Die Gesamtdichte ist 19 bedeutend gesunken, weil kein Jahrgang die Stär des Jahrganges 1928 erreicht. Sie fällt auch weit hin in den folgenden Jahren und ist 1939 auf ein Stundenfang von 524 Stück zurückgegangen, da d II- und III-Gruppe in diesem Jahr vergleichswei schwächer ist als in den Vorjahren. Auffällig vor allem die unverhältnismässig starke Abnahr

Jahrgänge von der III- auf die IV-Gruppe. Dies ist auf die in den letzten Jahren eingetretene Steigerung der Befischungsintensität hin. Die Steigerung der Befischungsintensität ist zu einem kleinen Teil sicher auf den Ausbau der deutschen Kutterfischerei zurückzuführen. Ausschlaggebend ist aber die intensive Fischerei der holländischen und belgischen Motorkutter und Motorlogger gewesen, die in einer Reihe von Jahren den Plattfischfang in der Deutschen Bucht betreiben. Diese verstärkte Befischung beanspruchte den Schollenbestand auf das äusserste und führte dazu, wie an anderer Stelle ausführlich dargelegt wurde (vergl. U. Schmidt, Fischmarkt 1939, Heft 5), dass die Reserven an Jahrgänge an untermassigen Schollen sehr stark erschöpft waren und dass in der Folge die schwachen Jahrgänge nicht in der Lage waren, den Ertrag zu den Anlandungen beizutragen, den man nach ihrer Individuenstärke von ihnen erwarten durfte.

Die niedrige Bestandsdichte des Jahres 1939 ist somit nicht nur auf natürliche Ursachen wie die Fluktuationen zurückzuführen, vielmehr hat auch die Erhöhung der Befischungsintensität einen nachhaltigen ungünstigen Einfluss auf die Dichte ausgeübt.

Zahlentafel 2.
Mittlere Länge der Altersgruppen (♂+♀) in cm.

(unter der mittleren Länge kursiv das Geburtsjahr).

	Altersgruppe II	III	IV	V	VI
	13·1	19·3	23·8	26·4	28·9
	1928	*1927*	*1926*	*1925*	*1924*
	13·9	**17·5**	**19·5**	**22·0**	**26·1**
	1931	*1930*	*1929*	*1928*	*1927*
	14·7	19·1	22·5	25·9	27·3
	1935	*1934*	*1933*	*1932*	*1931*
	14·3	19·7	23·9	26·1	27·7
	1936	*1935*	*1934*	*1933*	*1932*
	15·5	**20·1**	**24·8**	**26·9**	**28·7**
	1937	*1936*	*1935*	*1934*	*1933*

Zahlentafel 2 bringt sehr anschaulich die wechselseitigen Beziehungen zum Ausdruck, die zwischen der Bestandsdichte der Schollen und dem Wachstum bestehen. 1933 wirkte die grosse Bestandsdichte hemmend auf das Wachstum der Schollen ein. Mit dem Sinken der Dichte in den folgenden Jahren trat dagegen eine Beschleunigung des Wachstums ein, die 1937 deutlich bemerkbar ist und die bis zur Gegenwart anhält. 1939 sind die Schollen aller Altersgruppen sehr gut gewachsen und übertreffen bei weitem die Durchschnittslängen der gleichen Altersgruppen in den vorhergehenden Jahren.

Zahlentafel 3.
Hundertsatz der Schollen über 23 cm. in den einzelnen Altersgruppen.

	Altersgruppen III	IV	V	VI
1930	10	59	87	100
	1927	*1926*	*1925*	*1924*
1933	1	6	31	76
	1930	*1929*	*1928*	*1927*
1939	12	74	95	100
	1936	*1935*	*1934*	*1933*

Entsprechend der Wachstumsgeschwindigkeit verhält sich auch der Hundertsatz der Schollen über 23 cm. in den einzelnen Altersgruppen. 1939 erreichten von dem gut gewachsenen Jahrgang 1935 in der IV-Gruppe 74 v. H. der Schollen die Marktfähigkeit, während 1933 von dem langsam gewachsenen Jahrgang 1928 in der V-Gruppe erst 31 v. H. über 23 cm. gross waren.

Zahlentafel 4.
Verhältnis der Stärke der Jahrgänge.

Jahrgang	1922	1923	1924	1925	1926	1927
	85	25	20	50	25	35
	1928	1929	1930	1931	1932	1933
	100	32	22	18	25	35
	1934	1935	1936	1937		
	46	50	40	35		

Mit Hilfe des Durchschnittsfanges je Stunde und unter Berücksichtigung der Schwankungen der Wachstumsgeschwindigkeit ist das Verhältnis der einzelnen Jahrgänge zueinander errechnet worden. Der Jahrgang 1928 hat die Verhältniszahl 100 erhalten. Nur der Jahrgang 1922 kommt dem Jahrgang 1928 nahe. Die Jahrgänge 1934 und 1936 sind mittelstark, während die Jahrgänge 1925 und 1935 sich etwas darüber hinaus erheben. Etwas unter dem Durchschnitt liegen die Jahrgänge 1927, 1929, 1933, 1937 und ausgesprochen arm sind die Jahrgänge 1923, 1924, 1926, 1930, 1931 und 1932.

Investigations of Growth of Plaice on the North-West Coast of Holl in August and September, 1939.

By

J. J. Tesch.

THE following data were obtained by investigation of market samples of the smallest plaice categories ("Small III" and "II") at Ymuiden. The fishes had all been caught by small motor vessels within a few miles from the coast. The whole material of the months named comprises 3074 fishes, viz., 928 from the Terschelling grounds and 2146 from "Haaks" L.V. Owing to the outbreak of war no material from Terschelling came to hand during September.

It must be ascribed to the sharp market sele that the calculated average length of the I-gro doubtless too high; the smallest fishes of this represented in the "puf" being absent in our terial. Similarly we may assume that the lengths of the VI- and older groups are cert too low.

These age determinations have since been tinued monthly. No further comment is given

Plaice. Smallest Market Categories at Ymuiden.

Average Length of Year-Classes. Haaks and Terschelling Aug. and Sept. 1939.

Age-Group / Year-Class	I 1938		II 1937		III 1936		IV 1935		V 1934		VI 1933		V 19
cm.	Terschell. Aug. '39	Haaks Aug. & Sept. '39	Terschell. Aug. '39	Haaks Aug. & Sept. '39	Terschell. Aug. '39	Haaks Aug. & Sept. '39	Terschell. Aug. '39	Haaks Aug. & Sept. '39	Terschell. Aug. '39	Haaks Aug. & Sept. '39	Terschell Aug. '39	Haaks Aug. & Sept. '39	Terschell. Aug. '39
16	—	4	—	—	—	—	—	—	—	—	—	—	—
17	—	20	—	—	—	—	—	—	—	—	—	—	—
18	—	88	—	—	—	—	—	—	—	—	—	—	—
19	—	123	—	15	—	—	—	—	—	—	—	—	—
20	—	163	—	38	—	8	—	—	—	—	—	—	—
21	—	187	15	114	16	28	3	3	1	1	—	—	—
22	—	141	15	155	30	39	21	12	2	4	2	—	—
23	—	123	13	168	53	46	35	15	13	1	—	—	—
24	—	32	7	97	38	85	65	23	20	7	2	2	—
25	—	17	—	69	31	88	102	30	35	8	18	3	—
26	—	2	—	22	9	43	68	15	54	3	15	—	3
27	—	—	—	4	6	39	47	19	31	5	23	1	1
28	—	—	—	—	1	11	21	7	25	3	19	—	2
29	—	—	—	—	—	3	3	5	16	7	12	—	5
30	—	—	—	—	—	—	2	—	7	—	6	—	1
31	—	—	—	—	—	—	—	—	2	—	4	—	1
32	—	—	—	—	—	—	—	—	1	—	2	—	1
33	—	—	—	—	—	—	—	—	—	—	—	—	2
34	—	—	—	—	—	—	—	—	—	—	—	—	1
Total	—	900	50	682	184	390	367	129	207	39	103	6	17
Av. Length cm. .	—	20·8	22·2	22·6	23·5	24·3	25·1	24·9	26·2	25·6	27·2	—	29·3

The Stock of Dab in the Horns Reef Area.

By

Aage J. C. Jensen.

ıe number of dab in the depth-zone 10—30 m. e southern region has been calculated in the manner as that used for the plaice (see p. 128). ariations from year to year are due partly to ations in the strength of the year-classes, to the changes in the fishing. In 1936, the g year-class of 1935 has produced a great er of dab of 5—9 cm. length in the northern ı. During 1937 and 1938 this strong year-class een found in great numbers in the southern ı also in the size-groups 10—14 cm. and 9 cm. respectively.

lso in 1937 a strong year-class has arisen as ated by the great number of dab of less than length occurring in the southern region in

mparing the figures in the table with those aice in Tab. 1, p. 128, it will be seen that the er of dab was more or less twice that of the e. In the Horns Reef area the dab compete for with the plaice to a small extent only; although tock of dab for all that must play some rôle ıe growth conditions of the plaice, it should ted that there does not seem to be any notice- connexion between the density of the stock of nd the length of the age-groups of plaice as ı in Tab. 5, p. 130.

Catch per hour in a 50-feet Otter-Trawl with fine-meshed Cod-End.

(From: Komm. Danmarks Fiskeri- og Havunders., Dept. Dr. H. Blegvad.)

Year	Month	No. of Stations	<9 cm.	10—14	15—19	20—24	25—29	Total
Southern Horns Reef Region, 10—30 m.								
1934	VI	14	286	215	172	31	4	708
1935	VI	14	347	186	62	12	1	607
1936	VI	11	314	110	16	2	0·1	442
1937	VI	17	249	339	61	10	0·3	659
1938	V/VI	7	975	353	154	20	1	1503
„	VIII	7	762	288	131	19	1	1201
Northern Horns Reef Region. Depth-Zone 10—20 m.								
1934	VI	4	358	182	138	28	2	708
1935	VI	1	34	24	26	10	1	96
1936	VI	5	1118	38	19	2	—	1177
1937	VI	4	394	69	14	2	—	479
1938	VIII	6	236	157	33	4	—	430
Depth-Zone 20—30 m.								
1934	VI	3	39	69	55	12	1	176
1935	VI	3	63	121	116	28	7	335
1936	VI	2	93	60	13	10	1	177

Alterszusammensetzung der Seezungenbevölkerung in der Deutschen Bucht.

Von

U. Schmidt,

Biologische Anstalt Helgoland.

INFOLGE der verhältnismässig kleinen Stückzahl der Proben sind die Ungleichmässigkeiten in der Alterszusammensetzung erheblich. Indessen ist 1939 und in den vorhergehenden Jahren kein Jahrgang als besonders reich oder besonders arm zu erkennen. Die Nachwuchserzeugung scheint also verhältnismässig gleichmässig erfolgt zu sein. 1938 und 1939 spielen die jüngsten Altersgruppen, I und II, anteilsmässig eine grössere Rolle als 1934—37.

Die Längenmittel der Altersgruppen weichen in den einzelnen Jahren nur verhältnismässig wenig voneinander ab. Die Streuung der Mittelwerte ist im wesentlichen auf die geringe Stückzahl in jeder Altersgruppe und den dadurch hervorgerufenen grossen Fehler der Mittel zurückzuführen (lediglich die II-Gruppe ist bei den ♂♂ in den Frühjahrsmonaten 1937—39 etwas besser vertreten). Die Streuung ist naturgemäss bei den älteren Altersgruppen am grössten. Wesentliche Veränderungen in der Wachstumsgeschwindigkeit der Seezungen sind für die Jahre 1934—39 unter diesen Umständen nicht nachzuweisen. Das Wachstum ist im Gebiet der Deutschen Bucht praktisch konstant, wie dies schon früher von Bückmann festgestellt wurde (Vergl. Bückmann, Ber. deutsch. wiss. Komm. Meeresf., N. F., Bd. VII, Heft 2). Die mittleren Längen im Durchschnitt der Jahre 1934—39 stimmen ebenfalls befriedigend mit Bückmanns Werten überein.

Siehe Abbildung Seite 144.

Zahlentafel 1.

Mittlere Längen der Altersgruppen bei der Seezunge in cm.

Die Zahl der Bestimmungen, die den Mittelwerten zugrunde liegt, ist als Index beigefügt.

a. Mai—Juni

♂

A.-Gr.:	I	II	III	IV	V	VI
3	$10{\cdot}3^{6}$	$20{\cdot}3^{145}$	$24{\cdot}3^{81}$	$26{\cdot}9^{38}$	$29{\cdot}6^{19}$	$31{\cdot}9^{15}$
3	$12{\cdot}2^{49}$	$20{\cdot}2^{160}$	$25{\cdot}8^{84}$	$27{\cdot}6^{56}$	$30{\cdot}3^{32}$	$33{\cdot}4^{18}$
3	$10{\cdot}9^{22}$	$21{\cdot}0^{166}$	$25{\cdot}6^{180}$	$27{\cdot}9^{60}$	$30{\cdot}4^{31}$	—
3	—	$20{\cdot}1^{24}$	$25{\cdot}1^{27}$	$27{\cdot}3^{24}$	$30{\cdot}1^{11}$	—
3	—	$20{\cdot}4^{124}$	$24{\cdot}7^{49}$	$27{\cdot}2^{38}$	$30{\cdot}1^{9}$	—
3	—	$19{\cdot}2^{33}$	$25{\cdot}4^{34}$	$27{\cdot}8^{19}$	$29{\cdot}9^{15}$	—
hschnitt 1934—1939 ..	$11{\cdot}8^{1})$	20·4	25·3	27·5	30·3	32·2

♀

.....	$11{\cdot}1^{10}$	$20{\cdot}8^{52}$	$25{\cdot}3^{24}$	$28{\cdot}4^{13}$	$33{\cdot}4^{16}$	—
.....	$11{\cdot}9^{37}$	$20{\cdot}4^{37}$	$28{\cdot}1^{19}$	$30{\cdot}2^{32}$	$32{\cdot}6^{25}$	$34{\cdot}8^{16}$
.....	$11{\cdot}3^{10}$	$21{\cdot}6^{13}$	$27{\cdot}0^{45}$	$29{\cdot}8^{44}$	$32{\cdot}1^{44}$	—
.....	—	—	—	$29{\cdot}6^{8}$	$33{\cdot}0^{10}$	—
.....	—	$19{\cdot}8^{107}$	—	$28{\cdot}9^{11}$	$31{\cdot}3^{11}$	—
.....	—	$20{\cdot}8^{22}$	$26{\cdot}5^{13}$	$30{\cdot}2^{7}$	$32{\cdot}9^{9}$	—
chschnitt 1934—1939 ..	—	20·3	26·8	30·4	33·0	35·4

b. September—Oktober

♂

9	—	$22{\cdot}5^{29}$	$25{\cdot}4^{13}$	—	—	—
8	$18{\cdot}1^{178}$	$22{\cdot}9^{51}$	$26{\cdot}9^{18}$	—	—	—
7 Keine Fahrt						
6	$19{\cdot}4^{27}$	$23{\cdot}1^{46}$	$25{\cdot}8^{24}$	$28{\cdot}7^{12}$	$30{\cdot}8^{7}$	—
5	$20{\cdot}4^{13}$	$24{\cdot}8^{11}$	—	—	—	—
4	$16{\cdot}4^{33}$	$22{\cdot}7^{59}$	$24{\cdot}6^{9}$	$26{\cdot}6^{10}$	—	—
rchschnitt 1934—1939 ..	18·2	23·0	26·0	28·1	30·9	—

♀

39	$19{\cdot}6^{10}$	$24{\cdot}7^{32}$	$27{\cdot}6^{26}$	—	—	—
38	$19{\cdot}1^{62}$	$24{\cdot}4^{60}$	$28{\cdot}3^{27}$	—	—	—
37 Keine Fahrt						
36	$19{\cdot}2^{15}$	$25{\cdot}1^{18}$	$28{\cdot}0^{21}$	$30{\cdot}0^{22}$	$32{\cdot}0^{11}$	—
35	—	$25{\cdot}8^{11}$	$28{\cdot}6^{8}$	$30{\cdot}6^{18}$	$33{\cdot}9^{7}$	$35{\cdot}9^{11}$
34	$17{\cdot}4^{21}$	$24{\cdot}5^{37}$	$27{\cdot}9^{37}$	$31{\cdot}6^{15}$	$32{\cdot}8^{12}$	—
rchschnitt 1934—1939 ..	18·9	24·7	28·0	30·9	33·2	35·0

♂+♀

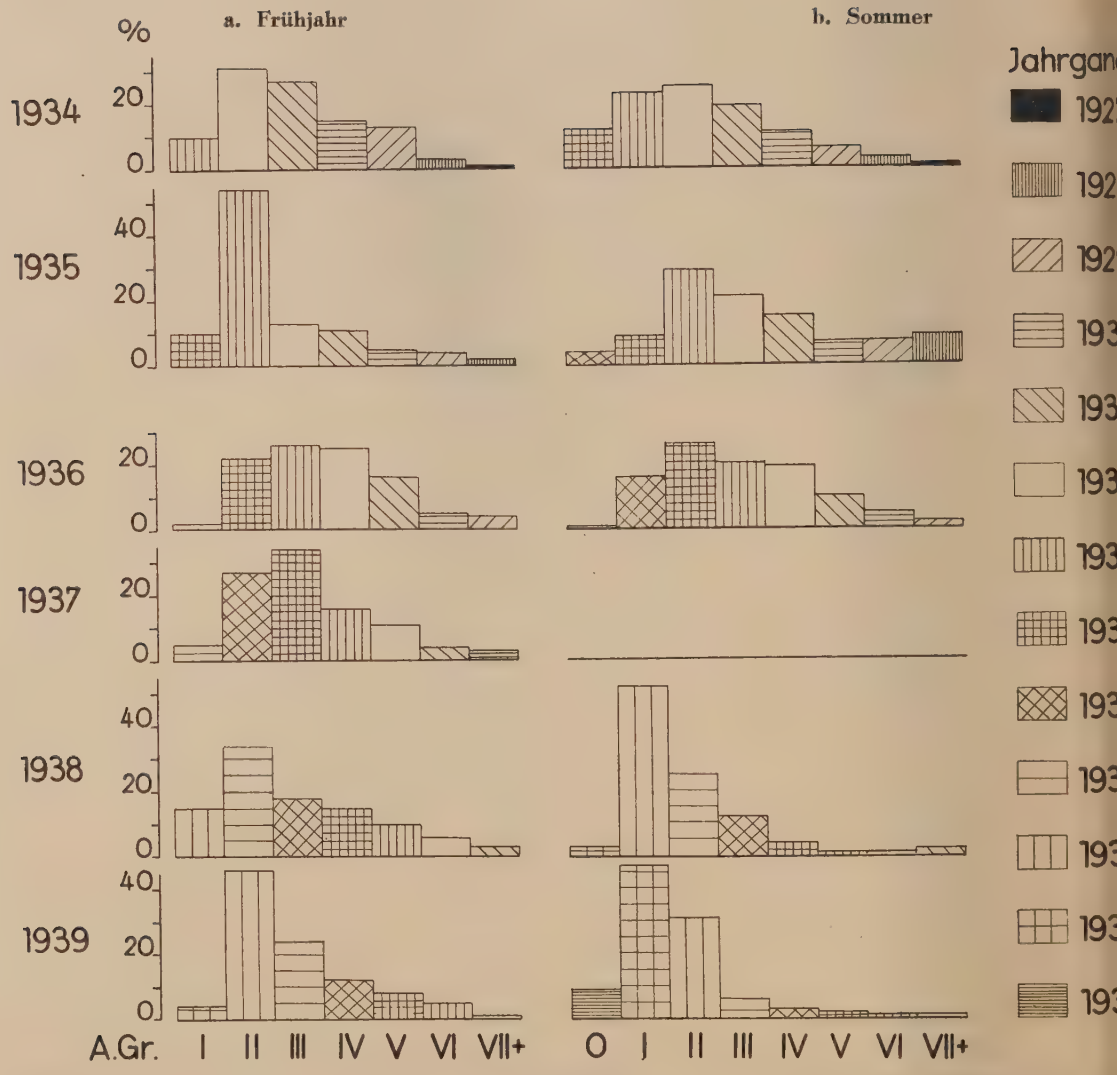


Abb. 1. Relative Alterszusammensetzung der Seezungenbevölkerung. a. Ganze Deutsche Bucht, Frühjahr (Mai—Ju
b. Umgebung von Helgoland, Sommer (Juli—September). Gerät: Kuttertrawl mit Decksteert. 1934—36: M.S. "Augus
1937—39: M.S. "Makrele".

Market Measurements at Ymuiden during 1937 and 1938, with Percentages of "Undersized".

By

J. J. Tesch.

order to arrive at a general estimate of the oss which the fishing industry might suffer if certain minimum size limits, such as are laid n in the international convention of London in 7, were enforced, measurements and weighings ome commercial fishings have been carried out muiden. The principal results are mentioned ne following table.

The examinations proved that "Small III" **plaice** inued to decrease in size in 1938, compared the preceding year, the mean length falling n 23·4 to 22·9 cm. The percentages of "Under-l" (below 23 cm.) both in number and in ght, rose to such an extent that more than half he fish landed had to be considered unmarket-. There is a tendency to make up for the poor ply of marketable fish by adding to them such ll fish as were formerly unsuitable.

The same remark applies to the **sole**, where the average length of the smallest category decreased from 21·6 to 20·8 cm. The percentage number of "Undersized" (below 21 cm.) is sometimes very large (about 60 %), and seems in 1938 to be on the increase.

Turbot, brill and **whiting** show little or no tendency to fall in mean length; in brill and whiting the percentage number of "Undersized" (in all three species 25 cm.) is even negligible. This ratio is highest in case of the turbot in the second quarter, of the brill in the third and of the whiting in the first and the last quarter of the year.

Nearly all the material had been caught by small motor vessels at an inconsiderable distance from the Dutch north-west coast.

Market Measurements at Ymuiden

mallest Categories of some kinds of Fish, with percentages of "Undersized" in Number and Weight

ies	Year	Number invest.	Weight in kg.	Av. Length in cm.	Number per 100 kg.	Undersized in % of number 1st Qu.	2nd Qu.	3d Qu.	4th Qu.	Whole year	Undersized in % of weight Whole year
ce	1937	13160	1557	23·4	845	41·0	39·4	33·4	56·3	40·5	37·0
ll III	1938	6919	779	22·9	888	53·5	53·3	57·7	—	54·5	51·5
	1937	48840	3964	21·6	1232	28·8	20·8	34·5	61·4	32·8	25·8
ll III	1938	24383	1843	20·8	1323	61·3	57·8	35·5	—	55·2	46·4
ot	1937	10353	4580	28·1	226	4·5	40·3	17·5	1·5	26·4	14·3
ll	1938	5528	2484	29·1	223	5·0	21·1	9·2	—	14·8	8·2
	1937	11377	3946	29·4	288	5·2	9·1	22·5	1·7	10·1	5·2
ll	1938	5524	2132	30·5	259	1·5	5·0	12·4	—	5·0	2·2
ting	1937	59162	9672	28·4	612	8·5	1·6	1·5	10·8	4·9	2·8
ll	1938	21413	3456	27·9	620	6·7	3·4	3·6	—	5·0	3·1

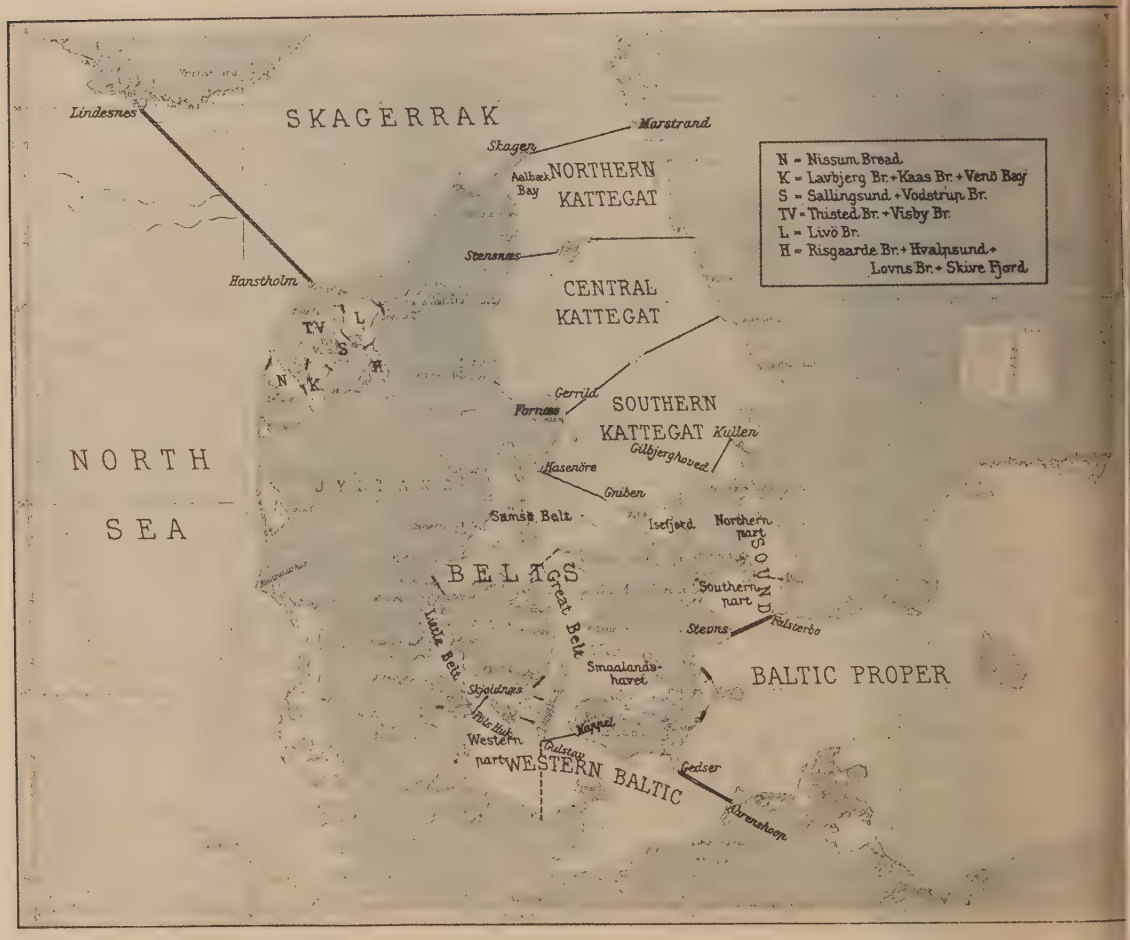


Fig. 1. Map of the Danish Waters showing Limits between the Different Areas.

Transition Area.

Introduction.

)NTRIBUTIONS have been received from Messrs. Dr. E. Fischer, Berlin, Dr. R. Kändler, Kiel, Dr. A. Molander, l, Sweden, and Dr. H. Blegvad, Copen-

far as the **hydrographical conditions** in the at and the Great Belt are concerned the rements of temperature and salinity taken at ghtvessels Anholt Knob, Schultz Grund, and ov Rev show that the temperature was above ıl during the whole period , October 1938 — er 1939. Especially high temperatures were ıred in both the upper and the lower water during October—November 1938 and August tember 1939. The *salinity* also was generally normal; in particular, a strong inflow of and warm water occurred in the bottom s during January-February 1939. At the ernmost station, Halskov Rev, the bottom ity decreased during the months of March-June below normal, but increased again considerably g the following months; this increase is also d at the more northerly stations.

ish-Larvae. During April and May 1939 in- gations have been made in Denmark into the ber of larvae of various winter and spring- ning fishes, and the results have been compared the averages from previous years. Dr. Kändler has given information as to the numbers of us fish-larvae in the western Baltic.

laice. The results are given of Danish investi- ns into the occurrence of the 0 and I-group. year-class 1939 seems to be weak almost every- e in the area. Furthermore, race analyses deal the 0-group, and quantitative investigations the frequency of the several age-groups, which are compared with the averages for the years 1927—39. Finally, the lengths of the several age-groups are recorded in relation to the depth. From Germany we have received various data regarding Baltic plaice, i.e., market measurements and investigations into age, length and number of fish per haul.

3. Cod. Danish investigations give information as to the number of fish per haul in various waters, stating the anomalies from the normal in the years 1930—39. Furthermore, measurements are given of the lengths of the 0 and I-group as well as the results of race investigations from the Belts and the Limfjord. German investigations deal with market measurements and with age, length, and number of fish per haul in the Baltic.

4. Dab. Data regarding catch analyses have been provided from both Danish and German investigators.

5. Flounder. Catch analyses are given from the Limfjord and the Baltic.

6. Herring. Danish investigations give information as to the number of larvae of autumn herring in the Belts, the western Baltic and the Sound, as compared with the averages for the years 1927—38; furthermore, the results are recorded of race analyses and of length and age from various regions.

7. Sprat. From Sweden, we have received detailed information regarding sprat and the sprat fishery off the Swedish west coast, including comparisons with former investigations.

8. Transplantation of Plaice. A report is given of the Danish transplantations in 1939, with a summary of the results obtained up to now.

H. Blegvad.

Denmark.

From the Danish Biological Station.

Director: Dr. H. Blegvad.

I. 1/10-1938—30/9-1939.

1. Larvae of various Winter- and Spring-Spawning Fishes.

For a number of winter- and spring-spawning fishes the subjoined table gives the mean number of larvae caught by the 2-m. ring-trawl per 30 min. during April and May 1939. When more than one haul was made at a station the mean number of larvae from the hauls made was used for the calculation. The figures in () state the corresponding means for the 5-year period 1935—39.

The number of **plaice** larvae is about nor (even though the investigations were carried too late in the season to be representative of amount of plaice larvae within the area consider The stock of **flounder** larvae is somewhat a normal whereas that of **dab** larvae is below nor In the southern part the number of larvae of **long rough dab** is higher than normal. The nur of **cod** larvae is on a whole considerably b normal. Very few **haddock** and **whiting** larvae caught.

Table 1.

Mean Number of Larvae caught by the 2-m. Ring-Trawl per 30-min. Haul during April and May,

	No. of Stat.	Plaice	Flounder	Dab	Long Rough Dab	Cod	Haddock	Wh
				April				
North. Kattegat	0	—	—	—	—	—	—	
Centr. „	0	—	—	—	—	—	—	
South. „	9	0·2 (0·2)	1·2 (0·6)	0·1 (2·1)	8·6 (14·0)	11·8 (124·8)	0·2 (0·2)	0
Sound	6	0 (0·1)	2·8 (0·6)	0·8 (1·2)	9·0 (3·7)	61·0 (97·9)	0 (0)	0
Belt Sea	14	0·2 (0·3)	2·2 (0·7)	0 (2·4)	3·6 (2·6)	41·3 (71·0)	0 (0)	0
West. Baltic	3	0·3 (0·5)	0 (0·2)	0·3 (0·8)	5·0 (1·2)	119·0 (82·0)	0 (0)	0
				May				
North. Kattegat	0	—	—	—	—	—	—	
Centr. „	3	0 (0)	0 (1·0)	2·0 (1·0)	4·0 (2·0)	4·7 (3·4)	0 (0)	0
South. „	4	1·8 (1·2)	2·8 (0·9)	0·5 (9·8)	8·0 (6·7)	16·0 (12·6)	0·8 (0·3)	0
Sound	5	0·8 (0·2)	2·4 (1·1)	0·4 (0·8)	0 (0·2)	4·2 (7·3)	0 0	0
Belt Sea	21	0·2 (0·1)	0·5 (0·5)	0·3 (2·2)	0·6 (1·0)	11·0 (30·0)	0 (0·02)	0
West. Baltic	8	0 (0)	0 (0)	0 (0·3)	0 (0)	16·0 (22·0)	0 0	0

The N. Kattegat has not been investigated with the ring-trawl in any of the years 1935—39.

Table 2.

Number of Plaice of the 0- and I-Group caught per 30-min. Haul in 1939

in the Johansen-Trawl at the Danish Coasts of the Transition Area, compared with the Number caught in each of the Years 1935—38, and with the Average of the Years 1927—1939.

	Skagerak			N. Kattegat			C. Kattegat			S. Kattegat			Belts			Sound			W. Baltic		
	0	I	No. St.	0	I	No. St.	0	I	No. St.	0	I	No. St.	0	I	No. St.	0	I	No. St.	0	I	No. St.
1935	—	—	0	99	46	11	39	5	14	39	0·3	21	25	1·2	88	49	2·2	19	9	0·4	11
1936	23	12	18	22	3	13	2	4	15	4	3	19	10	1·3	72	9	4	16	2	0·0	6
1937	61	11	16	50	19	10	0·9	0·2	13	17	0	17	10	0·9	81	7	0·0	15	5	0·0	13
1938	8	26	17	34	21	19	22	0	14	47	0·1	17	29	0·9	99	28	0·3	15	2	0·3	12
1939	56	0·6	19	34	4	17	5	0	14	8	0	18	8	0·5	126	4	0·2	17	11	0·0	21
Mn of 1927—39	—	—	—	47	26	—	20	7	—	13	0·9	—	17	1·1	—	12	1·5	—	8	0·1	—

For each station the numbers per 30-min. haul are calculated. The means of these values are given for each area.
As to the limits between the different areas see the chart, p. 146.

Plaice.

The strength of the 1939 year-class in the Skagerak was undoubtedly above normal, in all other areas below normal except in the W. Baltic. During spawning and just after spawning the temperature of the water in 1939 in all parts of the areas was above normal (see table 10), and therefore, — according to earlier investigations — one should expect a year-class stronger than normal. As it is seen this holds good for the Skagerak. For the Belts it has been shown that a high salinity in the bottom layer (a strong ingoing current) in Jan.—Feb.—March gives a poor year-class. During these months a strong inflow was found in 1939, in accordance with the small number of plaice of the 0-group recorded. The explanation given is that the more the eggs and larvae are carried towards the south to less saline water, the larger is the amount of fry which will be transported just along the bottom where they will perish in great number.

Table 3.

Number of Anal-Fin Rays in the 0-Group of Plaice

from the Coastal Fishing Experiments, 1939, with Anomalies from the Mean of 1928—38.

Area	Coast	Number invest.	Anal-fin mean	σ	σm	σo	Anomaly
Limfjord	Nissum Broad	90	54·00	1·88	0·198	0·140	—
Skagerak	Hanstholm—Hirtshals	170	53·86	1·89	0·145	0·102	—0·03
„	Hirtshals—Skagen	147	53·90	1·85	0·152	0·133	+0·04
Northern Kattegat	Aalbæk bay	173	53·83	1·79	0·136	0·096	—0·22
„	At Læsø	65	53·14	2·31	0·287	0·202	—
„	Frederikshavn—Stensnæs	52	53·65	2·08	0·288	0·204	—0·10
Central Kattegat	Stensnæs—Gerrild	34	52·53	2·27	0·390	0·276	+0·83
Southern Kattegat	Fornæs—Hasenøre	8	51·10	2·35	0·830	0·590	—0·10
„	North of Sjælland	59	51·83	2·97	0·386	0·273	—0·24
Belts	Off Samsø	120	50·10	2·81	0·257	0·166	—0·57
„	North of Fyn	60	49·28	2·14	0·276	0·195	—1·52
„	Northern Great Belt	38	49·74	2·34	0·380	0·269	—0·94
„	Southern Great Belt	118	49·81	2·30	0·213	0·150	—0·91
„	Smaalandshavet	23	49·96	2·51	0·524	0·371	—0·07
„	Little Belt	135	50·40	2·14	0·184	0·130	+0·12
Western Baltic	West of Gulstav	110	49·95	2·33	0·222	0·157	—0·30
„	South of Lolland	11	49·00	1·95	0·590	0·420	—0·70
Sound	Sound	8	51·10	2·36	0·830	0·590	—0·30

The number of anal-fin rays was
about normal in the Skagerak
a little below normal in the northern Kattegat
above normal in the central Kattegat
below normal in the southern Kattegat
below normal in the Belts
below normal in the western Baltic
below normal in the Sound.

The various explanations given as to the causes of the fluctuations in the racial character of the plaice seem to fail this year. Thus the temperature of the water was above normal in all areas during and just after the spawning season, which may be expected to give a high number of anal-fin rays. The salinity at the Skagens Rev bottom in Feb.—March—April was above normal, which should have indicated an inflow of larvae from the Skagerak stronger than normal, and consequently a number of anal-fin rays higher than normal in the northernmost Kattegat.

Neither for the Belts the low number of anal-fin rays can be explained by the inflow when we take the salinity anomalies as a measure of this factor (cp. table 10).

class 1937) in the southern and central Kattega was more or less about normal, also that of th 0-group caught at the coasts in 1937 had been abo normal. In the Belts the strength of the II-grou was somewhat above normal, while that of th 0-group caught at the coast in 1937 was somewha below normal. It is uncertain whether these di agreements are due to lack of material (casua deviations from the true values) or to other cause

In the Sound and the western Baltic the strengt of the II-group was below normal, as was that o the 0-group at the coasts in 1937.

The strength of the III-group (yea class 1936) in the southern and central Kattega and in the Belts as a whole was about normal, i the western Baltic above normal while the strengt

Table 4.

Number of the various Age-Groups of Plaice caught per 5-hour Haul
with the Eel-Tog 1st Oct. 1938—30th Sept. 1939 (m), and Anomalies (a) from Mean 1927—39.

	Depth-zone m.	No. of St.	0 1939 m	a	I 1938 m	a	II 1937 m	a	III 1936 m	a	IV 1935 m	a	V 1934 m	a	VI 193 m
N. Kattegat			no observations												
C. Kattegat	5—14	8	0	—10	446	+314	28	— 55	0	— 5	0	—0·2	0	0	0
	15—34	1	0	0	0	— 10	5	+ 1	5	+ 4	0	0	0	0	0
	>35	0	—	—	—	—	—	—	—	—	—	—	—	—	—
S. Kattegat	5—14	3	0	—20	127	+ 97	0	— 7	0	— 4	7	+ 7	0	0	0
	15—34	5	0	0	8	+ 7	10	+ 9	4	+ 3	0	—0·4	0	—0·1	0
	>35	1	0	—	0	—	0	—	0	—	0	—	0	—	0
Belts	5—14	26	7	—10	177	+140	34	+ 8	6	+ 1	0	—0·6	0	—0·2	0
	15—34	45	0	— 2	37	+ 29	7	— 1	1·6	—1·7	0·6	—0·8	0·2	—0·8	0 —(
	>35[1])	1	0	0	0	— 0·3	0	—0·6	0	—1·9	0	—1·5	0	—1·3	0 —1
W. Baltic	5—14	0	—	—	—	—	—	—	—	—	—	—	—	—	—
	15—34	9	0	0	0	— 0·3	2	— 5	9	+ 6	6	+ 3	0	0	0
Sound	5—14	5	0	0	0	— 2	0	— 38	4	— 51	2	— 6	0	—0·5	0 —(
	15—34	8	0	0	0	— 0·6	1·2	— 6	0	— 10	6	— 2	0	— 2	0 —

At each of the stations the numbers per hour are calculated. The means of these values are given for each area ar depth-zone. For the calculation of the mean numbers of the 0-group the stations after July 1st have been used. As to th limits between the different areas see chart p. 146.

[1]) Normal values smoothed for 3 consecutive age-groups acc. to the formula $\frac{a + 2b + c}{4}$

The strength of the I-group (year-class 1938) in the southern and central Kattegat and the Belts was considerably above normal, as was that of the 0-group in 1938 according to coastal fishing experiments (cp. Tab. 2) in these areas.

In the Sound and the western Baltic this age-group is not caught in any representative numbers at the eel-tog stations. Judging from the numbers of the 0-group found at the coasts in 1938 the strength should be expected to be above normal in the Sound and below normal in the western Baltic.

The strength of the II-group (year-

of the 0-group found at the coasts in 1936 (Tab. 2 was more or less below normal.

The strength of the IV-group, year-class 193 and older age-groups was so small in 1939, as i former years, that a close agreement with th number of fish of the corresponding year-class found at the coastal fishing experiments cannot b expected. According to the number of plaice four as 0-group at the coasts the year-class 1935 was very rich one. It was thus found in very gre numbers as I-group in 1936 at the eel-tog statio and partly also as II-group in 1937. It is characteristic consequence of the intensive fishe

iven this strong year-class was found in very numbers as V-group in 1939.

Limfjord.

he number of plaice caught during the fishing iments with the eel-tog in June 1939 varied inconsiderably from the normal. The subjoined y gives for various areas the mean number aice of all age-groups caught per 1 hour; the es in brackets give the corresponding means he period 1927—39:

Area	No. of Stat. (Hauls)	No. of Plaice
N	6	708 (712)
K	5	198 (168)
S	3	62 (92)
L	6	6 (11)
TV	6	26 (24)
H	4	0 (10)

The age composition of the stock of plaice in the Nissum Broad in June 1939 was as follows (mean catches with the eel-tog per 1 hour):

Age-Gr.	I	II	III	IV
June 1939, No.	26	596	84	1·4
Mean 1927—39, No.	152	308	206	54

Thus the II-Gr. (year-class 1937) predominated in the catches.

Length of the Age-Groups. (Tabs. 5/6). It is a characteristic feature that the length of the plaice increases with the depth corresponding to the minor density of the stock.

The fluctuations from year to year in the average length are in fairly close accordance to the fluctuations in the temperature of the water during the growth season of the plaice.

Table 5.

Length of the Age-Groups of Plaice

caught at the Quantitative Fishing Experiments with the Eel-Tog in 1939 (1st Oct. 1938—30th Sept. 1939).

	Depth zone, m.	0-Gr.	I-Gr.			II-Gr.		III-Gr.	
			Apr.—June	July	Aug.	Apr.—June	July—Aug.	Apr.—June	July—June
gat	1—14	—	15·6 (357)	—	—	19·9 (23)	—	—	—
	1—14	10·9 (41) Oct.	—	—	—	—	—	—	—
gat	15—34	—	15·5 (4)	—	—	20·2 (6)	—	—	—
	1—14	8·0 (7) July-Aug.	13·6 (161)	13·8 (178)	16·4 (64)	21·5 (88)		23·7 (11)	
	15—34	—	15·4 (79)	16·0 (12)	18·3 (67)	25·3 (29)		28·0 (4)	
ic	15—34	—	—	—	—	—	—	23·1 (8)	—

As to the limits between the different areas see chart p. 146. For the Belts no increment of length was found in the II- and groups during the different seasons of the year. Therefore, means for the whole period are given. 0·5 cm. to be added to mean lengths on account of the measuring to the nearest lower whole cm. (In brackets, number of plaice investigated).

Table 6.

The Average Length of Plaice caught by the Commercial Fishery during the Winter Months,

Oct. 1938-Feb. 1939 (*m*), and anomalies from mean 1931/32—1937/38.

Age-Group	II-Gr.				III-Gr.			
Depth-zone	< 25 m.		> 25 m.		< 25 m.		> 25 m.	
mean (*m*) anomaly (*a*)	*m*	*a*	*m*	*a*	*m*	*a*	*m*	*a*
Samsø Belt Great Belt	28·3 (62)	—0·3	31·1 (41)	+0·3	29·2 (18)	—1·7	34·8 (16)	+0·3
Little Belt — Western Baltic (western part)	31·4 (22)	+1·1	32·9 (50)	+2·1	34·1 (16)	+0·6	36·6 (25)	+2·5
Sound	31·3 (7)	2·1	—	—	32·2 (9)	0·5	—	—

The figures are simple averages from all samples investigated in the different areas and depth-zones, respectively.
As to the limits between the different areas see the chart p. 146.
Little Belt—Western Baltic to the east: Meridian through Gulstav light (Langeland).
Average length calculated of plaice above 26 cm. in length (some of the catches investigated consisted more or less of orted plaice, containing plaice below 26 cm. also). 0·5 cm. to be added to the mean lengths.

From the depth zone <25 m. in the area Samsø Belt—Great Belt the samples investigated were taken in the upper layer of water (in the Baltic current) and in the upper parts of the lower layer. The fluctuations from year to year in the average length tend to vary inversely with the temperature of the upper layer in the summer (cp. fig. below), which must be ascribed to the fact, that the temperature has been higher than the optimum temperature for the growth of the plaice (i.e., 14—15° C). In the depth zone >25 m. the fluctuations in the average length are directly proportional to the temperature of the lower layer (cp. fig. below) at the season of the highest temperature August—Sept.—Oct.

In the other areas considered most of the samples from the depth-zone <25 m. were taken in the lower layer. In agreement herewith the lengths of the age-groups in 1938/39 were above normal.

3. Dab.

The Limfjord.

Fishing experiments with the eel-tog were carried out in June 1939. The subjoined table gives for the various areas the mean total number caught per 1 hour; the figures in brackets denote the corresponding means for the year-period 1927—39:

Area	No. of Stat. (Hauls)	No. of Dab
N	6	70 (70)
K	5	26 (23·4)
S	3	18 (2·2)
L	6	3·0 (2·0)
TV	6	0 (2·6)
H	4	1·6 (0·8)

Fig. 2. Average Length of the II-Group Plaice in the Area Samsø—Great Belt. Samples from the Commercial Fishery.
In depths of *less* than 25 m.:
A = length in cm.
B = *surface* temperature at Schultz's Grund, L. V., in July—Aug.—Sept.
In depths of *more* than 25 m.:
C = length in cm.
D = *bottom* temperature at Schultz's Grund, L. V., in Aug.—Sept.—Oct.

In the western part the numbers were very nea to the normal, in the central parts however the were somewhat above normal.

The age composition of the stock of dab in th Nissum Broad in June 1939 was as follows (mea catches with the eel-tog per 1 hour):

Age-Gr.	I	II	III	I
June 1939, No.	22	44	3·4	0
Mean 1931—39, No.	30	42	12·0	1·

Thus the I- and II-Gr. were nearly normal, th III- and IV-Gr., however, considerably below no mal.

4. Flounder.

The Limfjord.

Investigations with the eel-tog were carried o in June 1939. The subjoined table gives for th various areas the mean number of all age-grou caught per 1 hour; the figures in brackets give t corresponding means for the period 1927—39:

Area	No. of Stat. (Hauls)	No. of Flounder
N	6	0·6 (10)
K	5	0·8 (2·6)
S	3	2·6 (2·2)
L	6	2·0 (6·0)
TV	6	1·0 (3·8)
H	4	13·6 (4·6)

On the whole the numbers caught vary onl inconsiderably from the normal numbers.

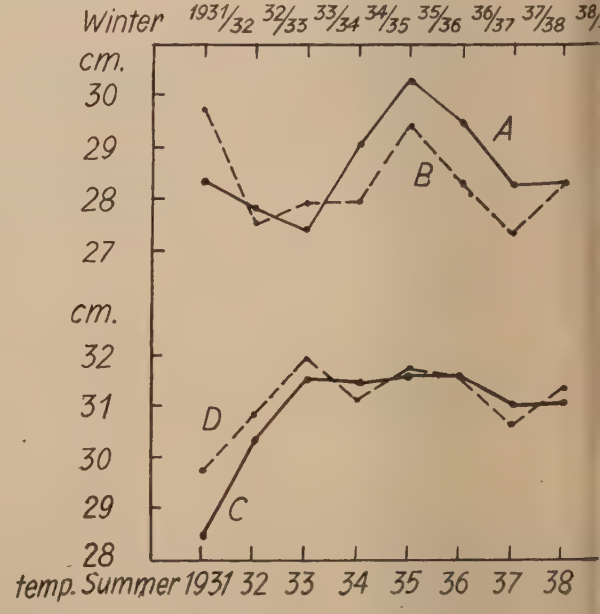


Table 7.

Number of Cod caught in the "Eel-Tog" per 1 hour in the various Waters.

The figures in brackets state the means for the 10-year period 1930–39:

No. of Stat. Apr.— Sept.	No. of Stat. June— Sept.	All Age-Groups	0-Gr.[1])	I-Gr.	II-Gr.	III-Gr.	IV-Gr.	V-Gr.	VI+Gr.
at 0	0	— (11·0)	— (1·8)	— (4·6)	— (2·8)	— (1·2)	— (0·1)	— (0·02)	— (0)
8	3	6·2 (45·2)	0·4 (47·0)	4·8 (4·0)	1·2 (2·0)	0 (0·4)	0 (0·2)	0 (0·04)	0 (0·02)
8	3	18·8 (31·2)	1·4 (16·2)	15·0 (15·0)	2·6 (3·2)	0 (1·2)	0·6 (0·4)	0·2 (0·4)	0 (0·04)
7	1	42·0 (68·6)	4·0 (13·4)	25·8 (24·0)	10·6 (23·8)	0·8 (9·0)	2·8 (2·0)	1·4 (2·2)	0 (0·3)
63	38	17·4 (38·2)	7·0 (32·4)	10·2 (11·8)	2·8 (4·6)	0·2 (3·0)	0 (0·8)	0 (0·2)	0·06 (0·1)
9	5	9·2 (25·2)	0·4 (2·4)	5·6 (16·0)	2·6 (4·0)	0·4 (2·6)	0·2 (0·4)	0 (0·6)	0 (0·02)

[1]) the 0-Gr. only catches made after June 1st are considered.

od.

Owing to the war conditions, the investigations he year 1939 were carried out to a smaller nt than in the previous years. In the southern Sea and the western Baltic a certain number auls were made in the deeper water in order nvestigate the effect of the lack of oxygen on stock of fish; the catch-figures for these waters therefore, somewhat lower than they ought to nd not quite comparable with the mean figures; — deviations of the I-Gr. in these waters are oubtedly due to this lack of oxygen, since a stock of the I-Gr. must be supposed to be sent in these waters which harboured a rich 0-Gr. he year of 1938. In the other waters the I-Gr. bout normal.

On the whole the stock of cod is somewhat ller than normally, this is mainly due to the poor 0-Gr. of the year 1939. But also the er age-groups (except the I-Gr.) are considerably w normal.

o w t h.

Measurements of cod were carried out on a tively large scale in the Belt Sea and Limfjord .

In the Belt Sea the following mean lengths were nd in August (the corresponding mean lengths the years 1923—29 are given in brackets):

0-Gr. 9·3 cm. 113 fish, (9·0 cm.)
I-Gr. 19·8 cm. 88 fish, (21·2 cm.).

iously the growth of the I-Gr. has been some- t below normal, no doubt due to the fact that I-Gr. belongs to the rich year-class 1938.

cial Investigations.

Vertebrae, Belt Sea, I-Gr. (year-class 1938):

Vert. prec., 18·37 (119 fish)
Vert. caud., 33·47 (119 fish)
Vert. tot., 51·84 (119 fish)

Rays of 2nd dorsal fin Belt Sea, I-Gr. (year-class 8) 18·40 (131 spec.).

The Limfjord.

Fishing experiments with the eel-tog were carried out in June. The following table gives for the various areas the mean total number caught per 1 hour; the figures in brackets denote the corresponding means for the year-period 1927—39:

Area	No. of Stat. (Hauls)	No. of Cod	
N	6	0	(0·6)
K	5	0	(0·6)
S	3	4·6	(1·2)
L	6	4·6	(1·4)
TV	6	146	(14·8)
H	4	12·6	(1·6)

In the central parts of the fjord the number caught was considerably above normal. Of the 0-Gr. only very few specimens were found (in the area L 0·6 per 1 hour, in the other areas none), the remainder of the cod caught (abt. 99 %) belonged to the I-Gr., the older age-groups not being represented at all.

The following mean lengths of cod of the I-Gr. were found:

June (eel-tog): 21·5 cm. (337 fish)
Sept. (eel-seine): 26·9 cm. (200 fish)

The growth is stronger in the Limfjord than elsewhere in the inner Danish waters (cfr. I-Gr. Belt Sea, August, 19·8 cm. only).

The following racial investigations of cod of the I-Gr. (year-class 1938) from the central part of the fjord were carried out.

Area	Month, 1939	Rays in 2nd Dorsal Fin	No. of Fish investigated	No. of Vert. S.	No. of Fish investigated
Thisted-Visby Br.	June	18·00	81	51·59	70
Livø Br.	June	18·12	43	51·27	28
Thisted Br.	Sept.	18·13	132	51·88	100
Livø Br.	Sept.	18·00	30	51·57	21
Sallingsund	Sept.	18·23	26	—	—

The number of rays was somewhat below normal (ca. 18·4), as was the number of vertebrae (51·9).

Table 8.

Number of Larvae of Autumn Herring caught per 30-min. Haul

with the 2-m. Ring-Trawl in October.

	Belt Autumn Herrring		Western Baltic Autumn Herring		Sound Autumn Herring	
	No. of larvae	No. of stat.	No. of larvae	No. of stat.	No. of larvae	No. of stat.
1934	46	17	75	3	5	18
1935	64	12	1	3	50	12
1936	54	24	68	4	44	10
1937	3	23	6	7	16	13
1938	31	39	7	4	7	6
Anomaly 1938 from mean of 1927—38						
	—97		—97		—33	

In case of hauls from several depths averages are used. The average for an area is the mean number of each station per 30-min. haul. The high values of the averages are due especially to the very rich year-class 1928 (in the western Baltic also 1929).

6. Herring.

There may seem to be a tendency to a fairl regular periodicity in the number of larvae wit a period length of between 3 and 4 years, whic has been explained as a consequence of the fa that a large amount of spawning herring produc a rich year-class, i.e., large amount of spawnin herring about 3—4 years later again producing rich year-class.

The predominance of the 3 and 4-year-ol herring, and of 2 and 3-year-olds in the purse-sein catches in the Northern Belts and in the Great Be corresponds to the rather great number of larva hatched in 1934, 1935 and 1936 (see Tab. 8). Th year-class 1933 was very poor. Of the rich yea classes 1931 and 1932 very small numbers are sti present.

The racial character corresponds pretty close the racial character expected at the various plac where the herring are caught.

7. Eel.

The Limfjord.

During fishing experiments with the eel-tog June 1939 in the various areas the followi numbers were caught per 1 hour; the figures

Monthly Mean of Temperature and Salinity (*m*) at the surface and the bottom at Anholt Knob, Series

		Anholt Knob										
		Temperature				Salinity ‰				Temperat		
		0 m.		28 m.		0 m.		28 m.		0 m.		
		m.	*a.*	*m.*	*a.*	*m.*	*a.*	*m.*	*a.*	*m.*	*a.*	*m.*
	Octbr.	12·3	+1·4	14·0	+1·9	21·1	+0·4	31·2	—1·0	12·5	+1·5	11·
1938	Novbr.	9·5	+2·4	12·6	+2·4	23·6	+1·7	31·6	—0·8	9·7	+2·5	11·
	Decbr.	5·5	+1·4	9·7	+1·6	23·1	+0·3	31·5	—0·6	5·3	+1·1	7·
	Jan.	2·2	0	7·7	+1·6	22·4	—1·1	34·3	+2·5	2·3	+0·2	7·
	Febr.	3·2	+1·8	5·4	+0·7	25·7	+2·6	33·8	+1·8	2·9	+1·4	6·
	March	2·9	+1·0	4·7	+0·4	20·9	+0·7	33·1	+0·6	3·0	+1·0	4·
	April	5·2	+0·7	5·0	+0·7	19·7	+0·5	34·1	+1·1	5·6	+1·0	4·
1939	May	9·6	+0·2	5·4	+0·5	17·8	—0·3	34·2	+1·1	9·6	+0·3	5·
	June	15·1	+0·9	6·9	+0·2	21·3	+2·4	33·9	+1·1	15·0	+1·0	6·
	July	16·9	+0·1	11·8	+2·1	20·2	+0·8	32·3	0	16·9	+0·4	8·
	Aug.	19·0	+2·3	13·3	+0·6	19·0	—1·1	33·0	+1·1	18·9	+2·3	11·
	Septbr.	17·6	+3·1	13·4	+0·3	17·0	—3·7	33·6	+1·8	17·3	+2·8	12·

The anomalies of the temperature

Table 9.

Age-Analysis and Racial Analysis of Herring,

1st Oct. 1938—30th Sept. 1939.

Locality	Date	Implement	Total age determ.	Size cm.	V. S.	Maturity	Age Distribution % 2	3	4	5	6	7
Yderflak Northern Belts	26/10 1938	Drift net	82	19—28	55·85 (81)	V—VI (V—VIII)	5	41	31	16	5	1
At Kerteminde	17/10 1938	Set net	59	18—26	55·78 (59)	V (III—VIII)	8	66	19	7	—	—
Nyborg Fjord	28/10 1938	Purse seine	90	17—25	55·80 (90)	III (II—VIII)	39	54	7	—	—	—
At Struer Nissum broad	9/6 1939	Pound net	174	19—26	55·55 (174)	V (III—VII)	10	76	13	1	—	—

S.: Total number of vertebrae; in brackets: number race-analysed. Maturity acc. to the scale of Johansen; ty of main part of the sample, in brackets: total range of maturity in the sample.

kets denote the corresponding means for the s 1927—39:

Area	No. of Stat. (Hauls)	No. of Eels
N	6	12·6 (2·6)
K	5	2·8 (1·4)
S	3	2·6 (2·6)
L	6	5·4 (2·4)
TV	6	4·4 (2·6)
H	4	4·0 (1·8)

The stock of eels (yellow eel) was on the le somewhat above normal.

The ascent of elvers into the watercourses flowing to the Limfjord was observed during the spring and summer. The ascent began in the latter half of April and culminated in the middle of May; in the first half of June it was still comparatively large; during July and August very few elvers only were observed. These observations will be continued in future years.

8. Hydrographical Conditions (Tab. 10).

The anomalies of the temperature have been above normal during the whole year.

A strong inflow of highly saline water took place in the bottom layer in January—February 1939.

l Halskov Rev Light Vessels, respectively, with Anomalies (*a*) from the Mean for a longer tical-Meteorological Annual).

linity ‰ 26 m.		Halskov Rev Temperature 0 m.		20 m.		Salinity ‰ 0 m.		20 m.			
m.	*a.*	*m.*	*a.*	*m.*	*a.*	*m.*	*a.*	*m.*	*a.*		
·2 30·5	+1·0	12·2	+1·1	12·3	+0·7	17·0	+0·8	24·7	+1·4	Octbr.	
·1 29·7	—0·7	9·5	+2·2	10·3	+1·9	17·1	+0·8	22·1	+0·6	Novbr.	1938
·5 26·4	—3·8	4·9	+0·9	5·4	—0·5	13·9	—1·7	16·4	—5·7	Decbr.	
32·7	+3·5	1·9	—0·5	4·8	+0·9	16·1	—0·7	24·8	+2·9	Jan.	
·1 33·3	+4·1	3·1	+1·1	5·2	+1·8	19·7	+4·9	26·5	+4·8	Febr.	
·5 30·8	+0·7	2·9	+0·5	3·6	+0·2	13·9	+0·5	19·7	—4·8	March	
·6 32·5	+1·2	5·7	+1·2	4·6	+0·3	14·4	+0·5	24·9	—2·7	April	
·8 32·5	+0·1	9·3	+0·4	6·5	+0·8	12·5	—0·5	24·7	—5·0	May	1939
·9 33·6	+1·2	15·2	+2·5	7·4	+0·3	15·0	+0·7	30·1	—0·2	June	
·0 33·2	+1·2	17·1	+1·4	9·5	+0·4	14·6	+0·7	29·8	+0·4	July	
·1 32·1	+1·1	19·1	+2·7	11·8	+0·1	12·0	—2·4	29·3	+1·7	Aug.	
·0 32·7	+2·9	17·5	+3·0	13·5	+0·3	12·9	—1·7	29·0	+4·3	Septbr.	

l during the whole year.

II. 1/10-1939—30/9-1940

OWING to the war the S/S "Biologen" had not been at disposal for research work since September 1st, 1939. It has, however, been possible by means of motor-boats to carry out a minor part of the research work hitherto carried out by the "Biologen".

1. No. of Larvae of various Winter- and Spring-spawning Fishes.

It has not been possible to continue these investigations. Weekly hauls with the Hensen Net, which for a series of years have been carried out from 3 light-ships in the Transition Area mainly for purpose of investigating the amount of fish-eggs and tiny larvae have, however, on the whole been continued. These investigations have shown that the spawning came very late in the spring after the severe winter of 1939/40. Thus, for April the number of cod eggs was more than twice the normal catch (for the years 1930—1940); owing to the ice no hauls were made during February and March.

2. Investigations in the Limfjord.

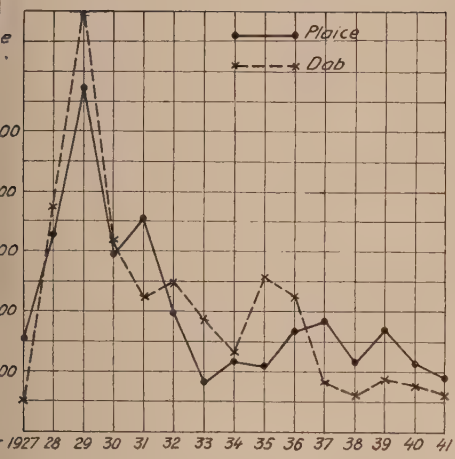
Fishing experiments with the eeltog were und taken in the latter half of May and in Septemb The subjoined table gives for the various areas mean number caught per 30 min. compared w the corresponding means for the period 1927— in ().

From the table it appears that the numb caught during spring and autumn of 1940 of two flatfishes, plaice and dab, which do not spa in the Limfjord but immigrate as young fish, considerably below normal and much smaller th in the preceding year.

The stock of the cod, flounder and eel also the whole are below normal throughout the L fjord.

The accompanying figure shows for the pla and the dab the number caught per 30 min. in Nissum Broad, during the years 1927—41. rapid decline in the number caught during the ye since 1929 is clearly seen, as well as the very number caught during 1940 and — it may be ad

Area	N. = Nissum Broad	K. = Kaas + Lavrbjerg Br. + Venø B.	S. = Sallingsund + Vodstrup Br.	L. = Livø Broad	T. V. = Thisted—and Visby Br.	H. = Risgaarde - Lovns Br. - Hvalpsund a Skive Fj.
			May 1940.			
No. of hauls	7	5	3	10	5	4
Plaice	291·4 (356)	43·4 (84)	19·0 (46)	4·1 (5·5)	0·8 (11·9)	0·3 (5·
Flounder	0·9 (0·5)	2·2 (1·3)	2·7 (1·1)	11·6 (3·0)	1·4 (1·9)	11·0 (23
Dab	8·6 (35)	1·6 (11·7)	8·7 (17·5)	0·3 (1·0)	0 (1·3)	1·0 (0·
Cod	0·3 (0·3)	0·2 (0·3)	0 (0·6)	1·2 (0·7)	4·6 (7·4)	0 (0·
Eel	0 (1·3)	0 (0·7)	0 (1·3)	0 (1·2)	0·4 (1·3)	0 (0·
			September 1940.			
No. of hauls	3	5	3	10	4	4
Plaice	198·2 (481)	27·8 (92)	3·7 (12)	0·9 (2·4)	0·5 (3·6)	0 (1·
Flounder	0 (0·5)	0 (0·4)	3·0 (0·4)	1·8 (2·6)	0·3 (0·7)	0·3 (0·
Dab	40·0 (143)	3·6 (32)	0 (10)	0 (1·5)	0 (0·4)	0 (0·
Cod	1·3 (11)	0 (1·5)	0 (1·2)	0·6 (1·5)	4·5 (5·2)	0·3 (1·
Eel	1·3 (0·1)	2·6 (2·0)	0·3 (1·9)	0·3 (3·1)	1·5 (4·9)	0·3 (3·



No. of Plaice and Dab caught by the Eeltog per 30 min.
g Spring + Autumn Investigations in the Nissum
d of the Limfjord. (No investigations in the spring of 1929 or in the autumn of 1927 and 1939).

— also in 1941. It further appears from the se of the curves that the numbers of plaice and vary in much the same way throughout the s.

The age composition of the stock of plaice in the Nissum Broad in spring and autumn of 1940 was as follows (mean catches in the eeltog per 30 min., the figures in brackets denote mean number for the years 1927—39): (see Tab. A.)

In spring the III-Gr. (year-class 1937) was predominating, in autumn however the 0-Gr. (1940). The composition of the stock according to year-classes is in good accordance with the results of the researches made along the west coast of Jutland on the amount of fry (0-Gr.) during the years. By these investigations the 1937, 1939 and 1940 year-classes were fairly rich and the 1938 one poor.

Valuations of the bottom were carried out in the Limfjord in spring as well as in the autumn. The valuation shows that the amount of food animals was very poor only; also the amount of other bottom invertebrates was far less than normal.

The mean weights in g./m.^{2} for the spring and autumn investigations of the principal bottom invertebrates were as follows: (see Tab. B.)

This may have been caused partly by the severe winter 1939/40 and partly (as the decrease has been going on for some years already) by the fact that the large stocks of *Zostera* have disappeared almost completely during later years.

The fact that the amount of food animals has decreased so rapidly in later years is in good accordance with the general decline in the fish stocks during the same period.

Group (year-class)	0 (1940)	I (1939)	II (1938)	III (1937)	IV[1]) (1936)
ng 1940	0 (0)	59 (76)	25 (154)	196 (103)	10 (27)
ımn 1940	72 (40)	91 (224)	6 (149)	32 (62)	0 (17)

Very few specimens (below ½ %) have been caught of the older age-groups.

Year:	1928	29	30	31	32	33	34	35	36	37	38	39	40
class food[1])	13	137	62	16	27	18	17	15	9	11	18	6	7
class food[2])	50	58	43	40	45	96	59	100	59	25	57	31	3

f. i., *Syndosmya alba, Mya juv., Nepthys sp., Pectinaria coreni.*
Corbula gibba, Nucula nitida.

Germany.

A. Dr. E. Fischer.

1. Plattfische und Larven.

Plattfische.

Zusammensetzung des Bestandes in der westlichen Ostsee nach Länge und Alter auf Grund von Marktmessungen.

a) Längenmessungen.

Anlandeort:	Warnemünde											
Fischart:	Scholle				Flunder				Kliesche			
Fangdatum:	30.VIII. 38	21.X. 38	24.V. 39	22.VIII. 39	30.VIII. 38	21.X. 38	24.V. 39	22.VIII. 39	50.VIII. 38	21.X. 38	28.V. 39	22.V 3
Menge in kg.:	19·5	42	32	4·5	78·5	5	1	9	62·5	67	97·5	59
Fangort:	4 Sm. quer ab v. Warnemünde	10 Sm. N. v. Warnemünde	7 Sm. NW. v. Darsser Ort	8 Sm. N. v. Warnemünde								
18 cm.	—	—	—	—	—	—	—	—	—	2	—	—
19	—	1	—	—	—	—	—	—	1	31	—	
20	—	9	—	—	6	—	—	—	15	73	4	3
21	5	7	—	—	17	—	—	—	46	81	54	6
22	9	20	—	—	22	—	—	—	113	49	66	7
23	15	11	—	—	32	6	—	—	89	71	94	4
24	18	19	—	—	33	4	—	—	68	40	86	4
25	18	11	—	1	18	2	—	2	44	31	91	5
26	13	24	—	—	21	5	—	—	24	42	45	3
27	8	13	—	2	25	5	—	1	10	4	34	1
28	8	13	—	1	10	4	—	—	6	2	23	1
29	2	8	—	—	15	—	—	—	2	4	26	
30	3	17	—	—	8	—	—	1	2	4	8	
31	2	10	—	1	15	—	—	1	—	2	15	
32	—	6	3	—	10	1	—	1	2	—	19	
33	—	4	2	—	3	1	—	—	—	2	30	
34	2	1	1	2	5	—	1	1	—	—	4	
35	—	—	5	—	8	1	—	2	—	—	8	
36	—	—	3	2	3	—	—	—	—	—	8	
37	1	1	2	—	8	—	—	1	—	—	8	
38	—	—	3	—	—	—	—	2	—	—	7	
39	—	—	1	—	3	—	—	—	—	—	—	
40	—	1	3	—	10	—	—	1	—	—	—	
41	—	—	—	—	—	—	—	—	—	—	—	
42	—	—	4	—	—	—	—	1	—	—	—	
43	—	—	3	—	—	—	—	—	—	—	—	
44	—	—	4	—	—	—	—	—	—	—	—	
45	—	—	1	—	—	—	1	1	—	—	—	
46	—	—	1	1	—	—	—	—	—	—	—	
47	—	—	4	—	—	—	—	—	—	—	—	
48	—	—	—	—	—	—	—	—	—	—	—	
49	—	—	2	—	—	—	—	—	—	—	—	
50	—	—	—	—	—	—	—	—	—	—	—	
51	—	1	—	—	—	—	—	—	—	—	—	
52	—	—	—	—	—	—	—	—	—	—	—	
53	—	—	1	—	—	—	—	—	—	—	—	
Anzahl:	104	177	43	10	272	29	2	15	422	438	630	39

b) Alterszusammensetzung der Schollen.

atum:	% Anteil der Jahrgänge: 1930	1931	1932	1933	1934	1935	1936	1937	Mittlere Länge:
III. 1938	—	—	1·0	—	4·8	32·7	59·6	1·9	26·22 cm.
X. 1938	0·6+	—	—	—	4·5	41·8	51·4	1·7	26·26 cm.
V. 1939	—	41·9+	6·9	—	25·6	25·6	—	—	40·19 cm.
III. 1939	—	10·0+	—	—	—	30·0	30·0	30·0	32·40 cm.

)r. R. Kändler.[1])

ıde.

nzahl der Schollen verschiedener Jahrgänge, fangen mit engmaschigem Grundschleppnetz Sprottrawl) in der Kieler Bucht und bei Fehmarn am 14.3.—3.4. 1939.

iefe m.	Anzahl d. Stat.	A.-Gr.	Insgesamt gefangen I	II	III	IV	V	VI	Anzahl pro Stunde I	II	III	IV	V	VI
—10	0		—	—	—	—	—	—	—	—	—	—	—	—
1—20	2		—	3	—	—	—	—	—	1·2	—	—	—	—
2—40	16		—	10	25	7	5	2	—	0·5	1·2	0·3	0·2	0·1

Mittlere Länge der Altersgruppen der Scholle Ende März/Anfang April 1939 (A.-G. III = Jahrgang 1936).

ltersgruppe (Jahrgang)	Anzahl	Mittl. Länge
I (1937)	13	21·7 cm. + 0·5 cm.
II (1936)	25	31·2
V (1935)	7	33·6
V (1934)	5	40·0
VI (1933)	2	42·0

Anzahl der 0- und I-Gruppe der Scholle in Fängen mit dem Johansen-Jungfischtrawl an der Küste der westlichen Ostsee (Eckernförde, Kiel, Travemünde, Warnemünde) am 27.7.—3.8. 1939:

An 35 Stationen (= Fängen) wurden insgesamt 23 Schollen der 0-Gruppe (= 1·7 Indiv. pro 30 Min.) und keine Schollen der I-Gruppe gefangen.

Rassenuntersuchungen an Schollen der 0-Gruppe: $n = 34$ mittl. Anz. der A $M = 49{\cdot}91 \pm 0{\cdot}40$ $\sigma = \pm 2{\cdot}33$.

[1]) Die Zahlen beruhen auf wissenschaftlichen Versuchsgen.

Heringslarven.

Mittlere Anzahl der Herbstheringslarven, pro 30 Min. mit Knüppelnetz (4.—6.11. 1938):

14 Stationen in der westlichen Ostsee, im Mittel 45 Heringslarven.

Andere Larven.

Am 12.—13.6. 1939 wurden an 7 Stationen in der Kieler Bucht mit dem Knüppelnetz gefangen:

2 Steinbuttlarven	0·9	pro 30 Min.
14 Klieschenlarven	8·9	„ „ „
13 Dorschlarven	8·6	„ „ „
2 Wittlingslarven	1·3	„ „ „
44 Sprottlarven	28·2	„ „ „

Während einer Untersuchungsfahrt am 17.—19.7. 1939 in der Kieler Bucht wurden ausserordentlich viele Klieschenlarven festgestellt, mit dem Eiernetz wurden bis 57 Stück pro m.² gefangen. Das Mittel aus 19 Stationen mit 20 m. und mehr Wassertiefe beträgt 22·8 Klieschenlarven. Danach ist der Klieschenjahrgang 1939 ganz ausserordentlich zahlreich vertreten.

2. Dorsch.

A. Dr. E. Fischer.

Zusammensetzung des Bestandes der westlichen Ostsee nach Länge und Alter.

Anlandeort:	Kiel	Eckernförde					Travemünde					Warnemünde												
Fangdatum:	8.VII.38	7.VII.39					12.VII.39					28.III.39							25.V.39					
Fangort:	Millionenviertel	Ausserhalb Eckernförder Bucht					3 Sm. quer ab Grömitz					Zwischen Heiligendamm und Nienhagen							7 Sm. NW. von Darsser Ort					
Fanggerät:	Schleppnetz	Schleppnetz					Schleppnetz					Angeln							Schleppnetz					
Altersgruppe:		I	II	III	IV	X+	I	II	III	IV	V	II	III	IV	V	VI	VII	VIII+	II	III	IV	V	VI	VII+
15—19 cm.	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20—24	—	2	1	—	—	—	28	26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
25—29	—	—	57	—	—	—	6	275	2	—	—	3	—	—	—	—	—	—	1	—	—	—	—	—
30—34	—	1	152	—	—	—	—	230	60	—	—	171	3	—	—	—	—	—	8	—	—	—	—	—
35—39	—	—	62	12	—	—	—	26	136	—	—	21	65	—	—	—	—	—	20	32	—	—	—	—
40—44	1	—	12	13	—	—	—	—	38	6	1	—	157	9	—	—	—	—	6	42	9	—	—	—
45—49	—	—	2	13	—	—	—	—	6	6	—	—	45	20	—	—	—	—	—	16	27	1	—	—
50—54	—	—	—	4	1	—	—	—	—	5	1	—	—	12	1	—	—	—	—	7	27	7	—	—
55—59	—	—	—	2	2	—	—	—	—	2	—	—	—	—	1	—	—	—	—	—	27	6	—	—
60—64	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	30	17	1	1
65—69	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	19	27	3	3
70—74	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	8	15	3	3
75—79	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	2	12	6	5
80—84	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	3	3	7
85—89	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	—	—	—	—	—	2
90 u. mehr	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	3
Anzahl:	25	3	286	44	3	1	38	557	242	19	2	195	270	41	2	2	4	2	35	97	149	88	16	24
%		0·9	84·9	13·0	0·9	0·3	4·6	65·2	27·9	2·2	0·2	37·3	52·9	7·8	0·4	0·4	0·8	0·4	8·6	23·7	36·4	21·5	3·9	5·9

B. Dr. R. Kändler.[1])

a) Anzahl der Dorsche verschiedener Jahrgänge, gefangen mit engmaschigem Grundschleppnetz (Sprottrawl) in der Kieler Bucht und bei Fehmarn am 14.3.—3.4. 1939.

Tiefe m.	Anzahl d. Stat.	insgesamt gefangen A.-Gr. I	II	III	älter	Anzahl pro Stunde I	II	III.	älter
1—10	0	—	—	—	—	—	—	—	—
11—20	2	5	17	2	1	2·0	6·8	0·8	0·4
21—40	16	132	266	25	35	6·3	12·7	1·2	1·7

(Altersgruppe I = Jahrgang 1938).

b) Mittlere Längen der I- und II-Gruppe des Dorsches in der Kieler Bucht, Ende März/Anfang April 1939.

Altersgruppe	(Jahrgang)	Anzahl	Mittl. Länge
I	(1938)	137	14·8 cm. ± 0·5 cm.
II	(1937)	283	23·2

The Stock of Herring in the Skagerak, the Kattegat and the Sound in 1939.

By

K. A. Andersson.

resent the herring fishery is mostly carried
h by the Swedish fishermen with trawl
uring late summer, autumn and winter in
ak and Kattegat as far south as Læsø. More-
e old drift-net fishery is carried on especially
h Læsø and the Swedish coast as well as
nd south of Anholt. Herring fishery with
eine is now without importance.
e trawl fishery, which is now by far the
nportant one, takes especially young herring
years old. Fully grown and older herring
age of 5 to 8 years form but a small part
trawl catches, although the age-composition
s in the various catches. Fig. 1 shows the
mposition in three catches from various parts
gerak and Kattegat. The curve for the catch from Måseskär is the more uncommon one as it mostly contains greater herring at an age of 4—10 years — generally mostly small herring are caught, and 1-year-old herring even are found in the catches. The trawl-caught herring from Kattegat between Skagen and Læsø are the smaller ones.

The trawl-caught herring mostly consist of a mixture of Kattegat autumn herring and Kattegat spring herring, the first-named generally forming the main part of the catches.

During a series of years the drift-net fishery for herring has been poor. In Fig. 2 a curve shows the age-composition of autumn-spawning drift-net herring, from the year 1939. For comparison a curve of the same race from the year 1938 has been drawn. Generally speaking the two curves are

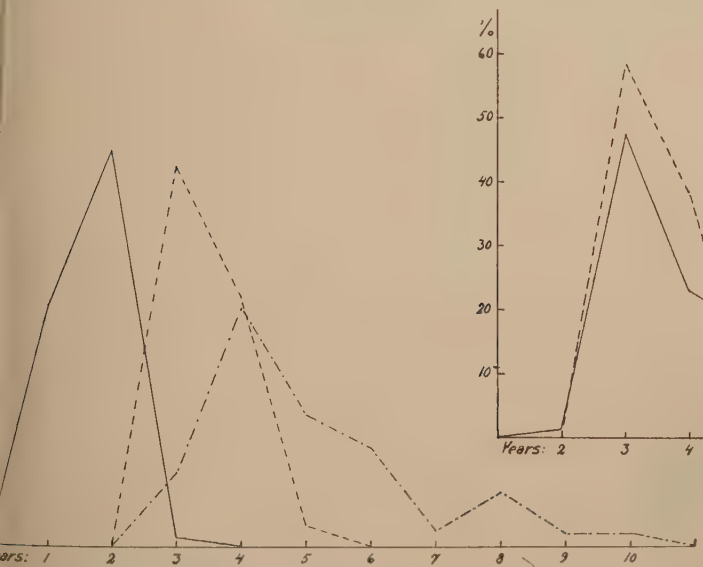


Fig. 1. Age-Composition of Herring, caught by trawl in the Skagerak and the Kattegat in 1939.
March 3rd, 1939, off Vinga Lighthouse, 31—63 m.
— — — — Aug. 21st, 1939, to the west from Hanstholmen.
—·—·—·— Sept. 19th, 1939, off Måseskär Lighthouse.

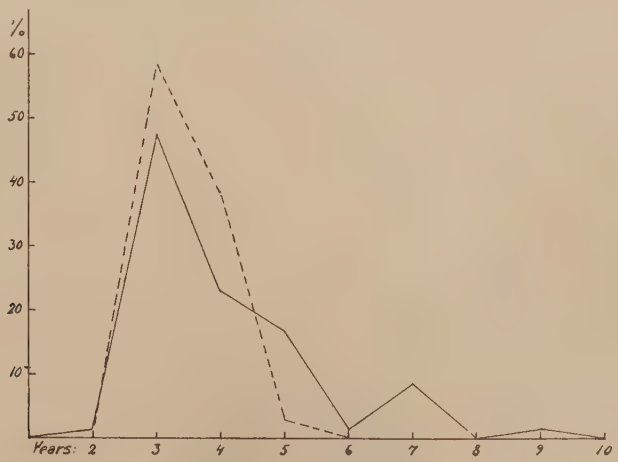


Fig. 2. Herring from the Kattegat, caught by drift-net. Age-Composition 1938 and 1939.
—— —— Sept. 1938.
– – – – Aug. 1939.

of the same type. In both cases the herring chiefly were 3 and 4 years old.

From these two curves it appears that there was no very rich year-class, at any rate not in 1938, otherwise this would have appeared as a dominant year-class in 1939. As the fishery was poor even in 1939 no one of the then 3 respectively 4-year-old year-classes can have been rich. It is evident from both curves that the herring stock is poor. The 3—4-year-old herring are the smallest caught by drift-net fishery and both years very few older herring were caught. The youngest year-class in the catches becomes relatively richest and it decreases year by year quickly in the catches. With such conditions in the herring stock fishery must become poor. At the west coast of Sweden it has been experienced earlier that the fishery can be plentiful only when at least one rich year-class is found which dominates in the catches through several years. Taken as a whole the stock of mature herring in Kattegat and Skagerak in 1939 must be considered a poor one.

Practically speaking autumn-spawning herring only are caught in the Sound, these are especially caught in the autumn by drift-nets.

In Fig. 3 a curve is recorded giving the age-composition in the catches from 1939. For comparison curves from the years 1937 and 1938 are given. All three curves are of the same type with the exception that the curve for 1937 shows a remainder of a 7-year-old year-class. Otherwise, these curves are similar to Fig. 2 for the Kattegat. The situation in the Sound for the three years 1937—39 was that no absolutely rich yea was found. The youngest year-class, the 3-ye one, is surely richest in percentage, but it disa quickly from the catches, when year by yea 3-year-old year-classes appear. The situati typical of a poor herring stock. The herring f also was very poor during the three yea question.

Variations in the Growth-Rate of the Herri in the Sound.

The herring fishery in the Sound is sub great variations. The following statement given in respect of the yearly catches of the S fishery:

1916	7640 ton	1937	857
1917	7470 „	1938	439
1918	5427 „	1939	529

From this it will be seen that the 191 was more than 14 times greater than the 19 This difference in the size of the catches m due to corresponding variations in the st herring.

The rich fishery in 1916 was due to th autumn year-class which had been dominant a series of years. We have here a good stration of what is said above in respect of K viz., that a rich fishery assumes a rich yea which has been dominant during several yea

I have made an investigation in order

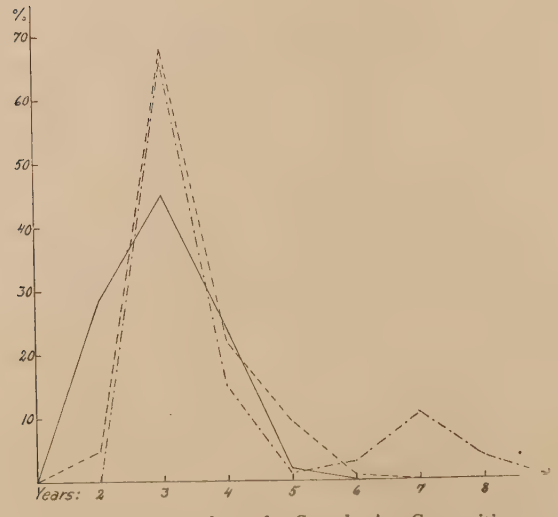


Fig. 3. Herring from the Sound. Age-Composition 1937—1939.
—·—·—·— Sept. 9th, 1937.
——— Oct. 11th, 1938.
— — — — Sept. 25th, 1939.

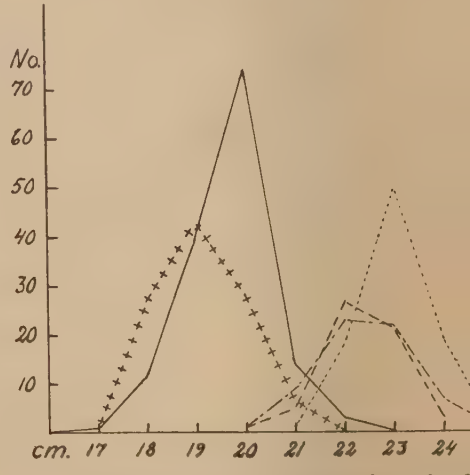


Fig. 4. Length of 3-year-old Herring from the S the Years 1916 and 1937—1939.
+++++ Aug. 12th, 1916.
——— Sept. 22nd, 1916.
— — — — Sept. 9th, 1937.
—·—·—·— Oct. 11th, 1938.
····· Sept. 25th, 1939.

whether the said conditions have had any in-
nce on the growth-rate of the herring. The
nd seems to be especially suitable for such an
stigation, as the herring conditions there are
cially simple. Practically speaking there is but
herring race, viz., an autumn-spawning race.
The investigations proved that a considerable
ease in the growth-rate took place during later
s when the stock had become smaller. In Fig. 4,
es are given of three-year-old herring from
samples from the year 1916 and from one
ple from each of the years 1937—1939. It will
noticed that the difference in size is very con-
rable. The average length for both samples
1916 was 19·13 and 19·68 cm. respectively,
e the average lengths for the years 1937—1939
22·36, 22·44 and 22·95 cm. respectively, a
rence in size that amounts to some 3 cm.
Most likely this difference in the growth-rate
ue to the variations in quantities of food avail-
for each individual when the stock is dense
when it is poor. If the herring has any
ibility at all to change the growth-rate — what
idently has — it will easily be understood that
of great importance to the feeding and thus
to the growth-rate, if, for instance, in the year
and the nearest preceding years there were
herring only within the same area where in
and the nearest preceding years were more
14000 herring. Here is, unfortunately, that
in the investigations that we have not in-
gated whether the increase in plankton was
ter in the later part of the thirties than during
the years 1913—1916, or if even other factors have played a part. Continued investigations in respect of these problems would be able to clear the connexion between effect and causes.

The question of variations in the growth-rate of the herring seems to be highly interesting and ought to be subject to more detailed investigations. If changes in the growth-rate of herring within a certain area definitively should prove to depend upon the greater or lesser density of the stock of herring it should be possible through investigations of the length of herring of a certain year-class to get an indication as to the greater or lesser richness of this year-class.

It may be mentioned that Molander has found similar variations in the growth-increment for sprat[1]).

In a previous paper I have also shown that the herring in the Botten Bay generally has a larger increment than the herring in the middle Baltic, and assumed that this is due to the richer growth in zooplankton in the Botten Bay than in the middle Baltic[2]). These conditions might even prove that the variation in the growth-rate within the Sound should actually be a problem of the supply of food.

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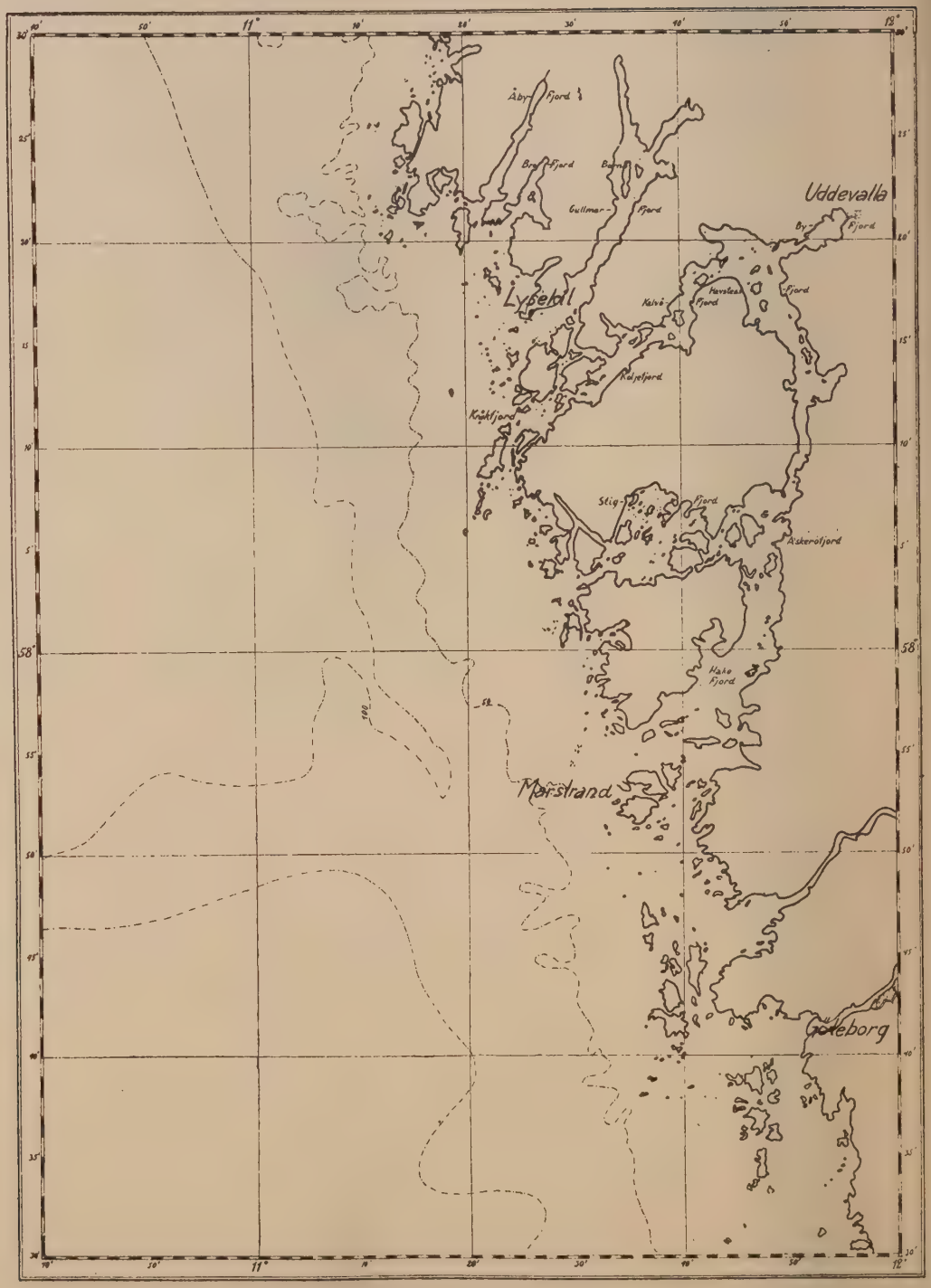
[1]) Arvid R. Molander: A research upon the Sprat off the west coast of Sweden I—II. Sv. Hydr.-Biol. Kommissionens Skrifter. N.S.: Biologi, Bd. II nr. 4 and 5. Stockholm 1940 and 1942.

[2]) K. A. Andersson: A Study of the Rate of Growth of some Fishes in the Baltic. Rapp. et Proc.-Verb. Vol. CVIII. Copenhague 1938.



Map of the Uddevalla Fiords.

Sprat and Milieu-Conditions.

By

Arvid R. Molander.

Year-Classes and Catches.

The stock of sprat at the Swedish west coast subjected to considerable changes due to nstantly recurring changes in the strength of e year-classes. The life of the sprat is short d this results in contemporary year-classes being w in number. The older ones further being presented by few individuals, it is chiefly the ntribution of the I- and II-groups that leaves mark on the stock. It can, therefore, clearly seen on these age-groups if a year-class is very ong or very weak, especially in the occurrence the I-group. A change in strength of the I-group anifests itself also in the stock of sprat and oduces likewise the short-periodical changes or ıctuations in the composition of the stock of sprat, ıich have so often been observed (Tab. 1).

Table 1 clearly shows how the year-classes of e sprat change and what importance the I- and -groups have for the stock. The contribution of e I-group gives, in the first place, information as the relative strength of the year-class. One otices, e.g., that the I-group was strong in the ars 1934, 1936 and 1938, which implies that the ar-classes 1933, 1935 and 1937 can be marked good ones, whereas the year-classes 1932, 1936 d 1938 should be considered as poor ones (cfr. rther Fig. 1). Of course, this does not necessarily dicate that a strong contribution of the I-group eans a strong year-class, unless rich catches should ppear at the same time. The I-group generally nstitutes the principal part of the catches of rat, and a strong I-group thus means a good eld. In Fig. 2 I have therefore tried to give a aphical account of the percentage strength of the group in the stock off the Skerries from 1933 to 1938. In the same figure, I have also given a curve showing the catches of sprat in the Uddevallafiords during the same period. It has not been possible to obtain the exact figures of the catches off the Skerries for these years, and furthermore, on account of the rapid evolution of the trawl-fishery, the sprat-fishery in its entireness has been submitted to such changes, that the figures of the catches from the different years are not directly comparable. The fishery in the Uddevallafiords clearly indicates the yearly changes in the catches of sprat. The figure displays how very closely the catches follow the changes of the I-group and shows also that in 1934, 1936 and 1938 the I-group was not only relatively stronger than the other simultaneously occurring year-classes, but also that it

Table 1.

The Percentage Occurrence of I—V-Groups in the Stock of Sprat from the Open Sea 1933—1939.
(Molander, 1940.)

Year	I-Gr.	II-Gr.	III-Gr.	IV-Gr.	V-Gr
1933 %	14·2	64·2	16·8	3·8	1·0
year-class	1932	1931	1930	1929	1928
1934 %	82·0	15·0	3·0	—	—
year-class	1933	1932	1931	1930	1929
1935 %	61·5	33·5	5·0	—	—
year-class	1934	1933	1932	1931	1930
1936 %	81·2	11·5	6·7	0·4	0·2
year-class	1935	1934	1933	1932	1931
1937 %	34·9	58·0	6·0	1·1	—
year-class	1936	1935	1934	1933	1932
1938 %	81·0	14·8	3·2	—	—
year-class	1937	1936	1935	1934	1933
1939 %	17·7	71·1	8·8	2·4	—
year-class	1938	1937	1936	1935	1934

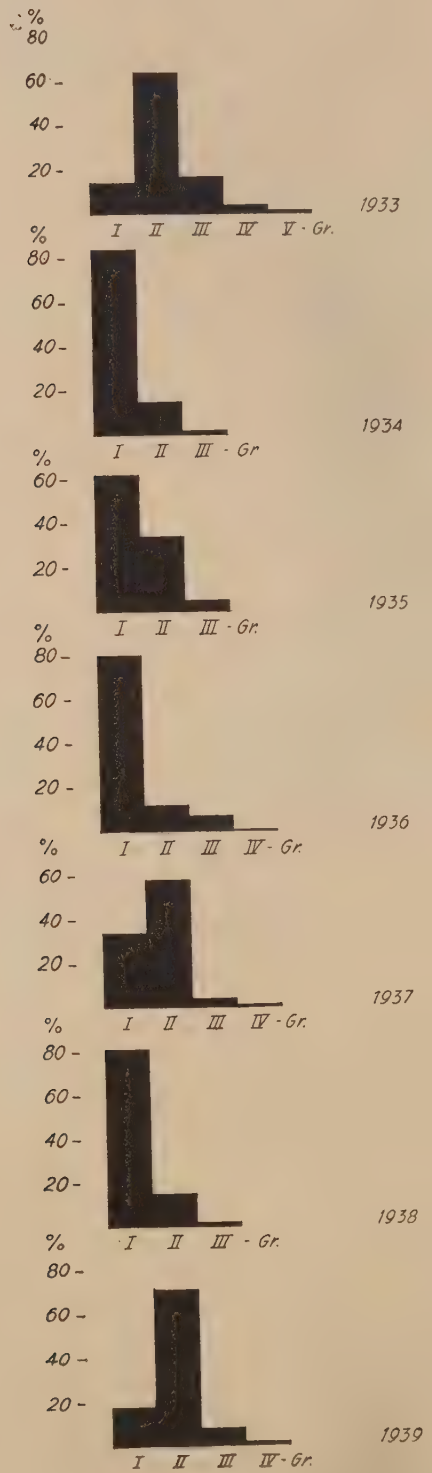


Fig. 1. The percentage distribution of the differen groups of sprat caught off the Skerries during 1933-

was absolutely much stronger than the I-group other years, or in other words, that in the ye in question strong year-classes were present.

These changes in the stock concerning distribution of the year-classes do not appear clearly in the archipelago of Bohuslän and fiords, because a considerable emigration of s takes place already at the I-Gr.-stage, and there the older year-classes are very scarcely represe there. An example from the Uddevallafiord shown in table 2.

But also here certain fluctuations will noticed in the relative strength of the I-group, most clearly this appears in the years 1934 1938 (the year-classes 1933 and 1937), in wh the catches also were considerable — a fur proof of the strength of the year-classes 1933 1937 (Fig. 2). Furthermore, judging from catches of 1936, the year-class 1935 also was str although the I-group in this case does not domi quite so strongly in the stock. The relatively g catches of 1935, in spite of the weakness of I-group, were due to the II-group this year (y class 1933) being very numerous in the cat (Fig. 2).

The conditions in the other fiords of Bohu are very similar to those of the Uddevallafi concerning the composition of the stock and dominating importance of the I-group. Here the figures of the catches follow the more ma changes of the percentage contribution of the of the I-group.

II. The Fluctuations in the Year-Classes and Connexion with Hydrographical and Met logical Conditions.

In order to investigate the possibility of connexion existing between the fluctuations i year-classes and different hydrographical meteorological factors, table 3 has been com from the *Svenska Hydrografisk-Biologiska missionens fyrskeppsundersökningar.* This comprises the mean monthly temperatures salinities from the depths 0, 10 and 20 m. at L. V. during the months April—July from 19 1938. The depths mentioned have been chosen regard to the chief occurrence of the eggs of within this layer. As spawning takes place April to July, these months have naturally included in order to obtain a good mean Probably the principal spawning off the Sk in the Skagerak takes place in May.

Rollefsen (1930) has called attention fact that the eggs of cod are susceptible to mechanical action. Concerning the eggs of Höglund (1938) has pointed out that som of mechanical action might occur throug

-motions, especially in rough sea. As the wave-
on is dependent on the force of the wind and
may be assumed that with strong wind and
prevailing a greater number of sprat-eggs are
oyed than in calm weather, I have also
ded in the table the monthly mean values of
orce of wind in order to get the measures for
possible effect on the stock of sprat-eggs.
t has not been possible from the mean
eratures and salinities in table 3 to show any
t connexion between these values and the
uations in the year-classes. Yet, sometimes, the
ience of temperature is apparent, but it does
seem to have any determining influence on the
lopment of the varying strength of the different
-classes. On the other hand, there exists a
er surprising connexion between the force of
wind during the months in question and the
tuations in the different year-classes. I have
d to express this clearer in Fig. 3, in which I
e drawn a curve showing the mean value of the
e of the wind for the months April—July
ing the years 1932—1938, as well as a curve of
percentage contribution of the I-group for the
erent years, in this case meant to represent the
ngth of the year-classes. The percentage-figures
tioned allow, in connexion with what we know
ut the size of the catches of sprat (Fig. 2), a
rly reliable estimation of the mutual strength-
ditions of the year-classes. In the same figure,
ave also included a curve, according to Hög-
nd (1938), which shows the number af fry,
t has been obtained by the Hensen-net per station
the Skagerak and within the Archipelago at the
pth of 0—10 m. in 1932—1934. 35 stations
ve been investigated every year. I have assumed
as probable that if in one year a larger number
fry is obtained by these hauls than in any other
ar, this means that the eggs in the former case
have had greater possibilities to escape the dangers, which threaten them from all parts, and probably not least by wind and waves. *Fig. 3 shows how closely the variations in the force of wind agree with the changes in the size of the year-classes.* At lower mean values of the force of wind for one year (e.g., 1933, 1935 and 1937) the strong year-classes are simultaneously to be found. In Fig. 3 the various year-classes are represented by their respective I-groups which — as pointed out above — satisfactorily characterizes the strength of a year-class. It also shows that during the years of 1932—1934 the number of herring fry per station was the highest in the year 1933 or the year, when the mean value of the force of wind was very low.

As already mentioned, the spawning in the Skagerak outside the Skerries seems to be most extensive in May. In Fig. 4 I have therefore entered curves giving the force of the wind in May during the years 1932—1938 at Vinga and Fladen L. V., as well as a curve of the percentage contribution of the I-group as in Fig. 3. Also here the same coincidence is found between the fluctuations of the year-classes and the force of the wind. In 1937

Table 2.

e Percentage Occurrence of the I—III-Groups in the Stock of Sprat from the Uddevallafiords, 1933—1939. (Molander, 1940).

Year		I-Gr.	II-Gr.	III-Gr.
1933	%	75·0	12·5	12·5
	year-class	1932	1931	1930
1934	%	99·0	1·0	—
	year-class	1933	1932	1931
1935	%	72·5	25·5	2·0
	year-class	1934	1933	1932
1936	%	90·6	9·4	—
	year-class	1935	1934	1933
1937	%	94·7	5·3	—
	year-class	1936	1935	1934
1938	%	96·3	3·7	—
	year-class	1937	1936	1935
1939	%	78·6	21·4	—
	year-class	1938	1937	1936

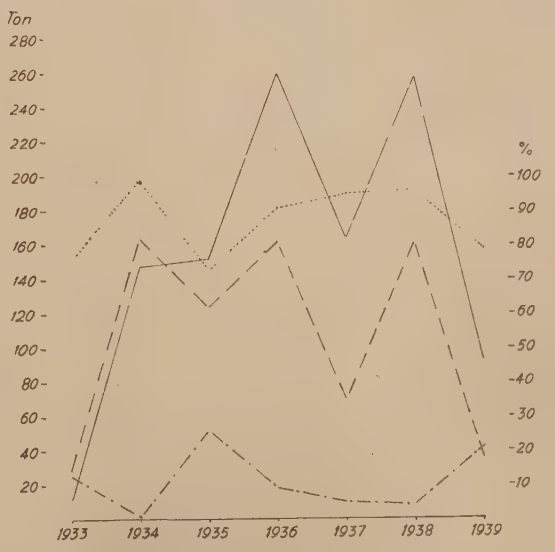


Fig. 2.

——— Catches of sprat in the Uddevalla fiords 1933—1939.

— — — The percentage contribution of the I-Gr. to the stock off the Skerries fiords.

- - - - - - - - The percentage contribution of the I-Gr. to the stock in the Uddevalla fiords.

—·—·—·— The percentage contribution of the II-Gr. to the stock in the Uddevalla fiords.

exceptional conditions prevailed as to the mean value of the force of wind from Vinga L. V., but I shall revert to this later.

In order to explain more clearly the changes in the force of wind during the month in question, I have entered curves of the percentage occurrence, in days, of various forces of wind during May in the years 1932—1934 (Fig. 5), and in the years 1937—1938 (Fig. 6). It is obvious that the somewhat stronger winds (over 4 Beaufort) occur more often in the years 1932 and 1934 than in 1933, and likewise in 1938 as compared to the year 1937.

The influence of temperature, however, must not be disregarded, when the possible causes of the fluctuations in the strength of the different year-classes have to be traced. It is known that the eggs of sprat develop more rapidly at higher temperatures of the water. This quicker development of the eggs into fry certainly must have some influence o percentage loss of eggs (due to other outer acti such losses being smaller under equal condi than those inflicted on a stock of more s developing eggs. It is thus noticeable that in like, e.g., 1933, when the surface temperatu May and June was relatively high and the of wind low, the year-class became very goo may also be observed that, in spite of the strong wind at Vinga L. V. in May 1937, a strong year-class had developed, probably d the influence of the high temperature at that the development of the eggs hereby, being has any destructive influence of the higher force of may be neutralized to some extent. The temperature as well as the high force of wi 1938 is very likely to a great extent responsib a retardation in the development of the spra

Table 3.

Mean Values of Temperature and Salinity from April to July in the years 1932—1938 from Vinga L. V.

The values apply to the depths of 0, 10 and 20 m. In addition, the mean values of the force of the wind per month during the same time are given (in Beaufort).

Year	Depth	0 m. t°	0 m. S ‰	10 m. t°	10 m. S ‰	20 m. t°	20 m. S ‰	Wind-force
1932,	April	4·30	19·8	4·50	22·5	5·14	33·6	2·6
	May	9·81	19·2	8·77	23·1	6·10	33·4	2·7
	June	14·02	19·8	12·14	26·7	8·89	33·3	2·7
	July	18·61	19·6	17·12	24·1	12·69	32·3	2·1
1933,	April	4·92	23·9	4·88	27·9	4·34	32·1	2·8
	May	10·28	18·6	7·34	25·9	6·49	32·9	1·6
	June	16·86	17·1	12·23	25·3	8·24	33·7	2·2
	July	18·54	22·1	16·42	28·8	12·92	32·9	2·5
1934,	April	5·35	17·6	5·02	20·7	4·96	32·5	2·8
	May	10·82	20·4	8·50	27·0	7·13	32·8	3·0
	June	14·22	19·1	12·86	24·6	9·11	30·7	2·8
	July	17·78	23·0	15·39	26·8	11·70	32·2	2·6
1935,	April	5·29	19·9	4·84	24·1	4·68	30·8	2·7
	May	9·57	18·7	7·83	23·8	5·90	33·5	2·2
	June	14·11	19·8	11·59	26·0	9·21	32·9	2·6
	July	17·09	22·9	15·46	28·0	14·54	31·4	2·5
1936,	April	4·20	22·7	4·29	27·4	5·02	33·7	3·7
	May	9·69	18·5	6·87	25·0	5·21	33·4	2·4
	June	15·54	18·6	11·90	23·3	7·30	33·8	2·0
	July	18·64	19·6	17·71	24·4	14·11	33·8	3·0
1937,	April	4·52	21·4	3·84	24·9	3·32	32·6	2·1
	May	10·87	18·9	8·96	23·6	5·13	33·5	2·6
	June	14·13	21·2	13·31	23·7	10·45	30·8	3·1
	July	17·68	22·8	15·99	28·2	13·66	31·4	2·1
1938,	April	6·18	26·8	5·40	28·7	5·62	30·2	3·6
	May	9·22	20·5	8·39	23·2	7·57	29·7	3·1
	June	13·11	22·5	12·63	24·7	10·72	32·0	3·6
	July	16·66	19·4	16·00	20·8	13·72	29·7	2·5

nd has thus been the cause of the weak year-class 938.

An earlier observation (M o l a n d e r, 1940, ig. 37) shows that during dry years and warm ummers good year-classes often seem to arise (e.g., 914, 1925, 1933) and this may therefore be ex-lained by the fact that during such years also the vinds as a rule are weaker and the temperature of he water higher, thus causing a favourable develop-ment of the eggs.

At the final estimation of the causes of the luctuations in the year-classes several other factors must be considered than those quoted here, and may suggest certain possibilities for solving this important question.

III. The Growth of the Sprat and its Variations.

The fluctuations in the stock of sprat, caused by the contribution of year-classes of different strength correspond to certain changes in the growth of the sprat. This is certainly dependent on the type of growth, to which the sprat belongs (M o l a n d e r, 1940), but beyond that, another change in the growth appears, which probably depends on the number of individuals in a year-class. In table 4 the average lengths of sprat belonging to the I—IV-groups of the sprat of the open sea (according to Tab. 1) have been recorded with the average lengths of the sprat belonging to the same age-groups of the year-classes 1935—1938.

The average lengths of sprat from the Uddevalla-fiords are given in table 5. The average size of the sprat of the I—III-groups in the year-classes 1935—1938 are entered in the tables. It is clearly recognized from these tables and from Fig. 7 that, when the I-group is strongly developed, i.e., numerically rich (cfr. Tab. 1 and Figs. 1—2), e.g., 1934, 1936 and 1938, the average length of each fish is less than when the corresponding age-group is weakly represented (e.g., 1935, 1937, 1939; cfr.

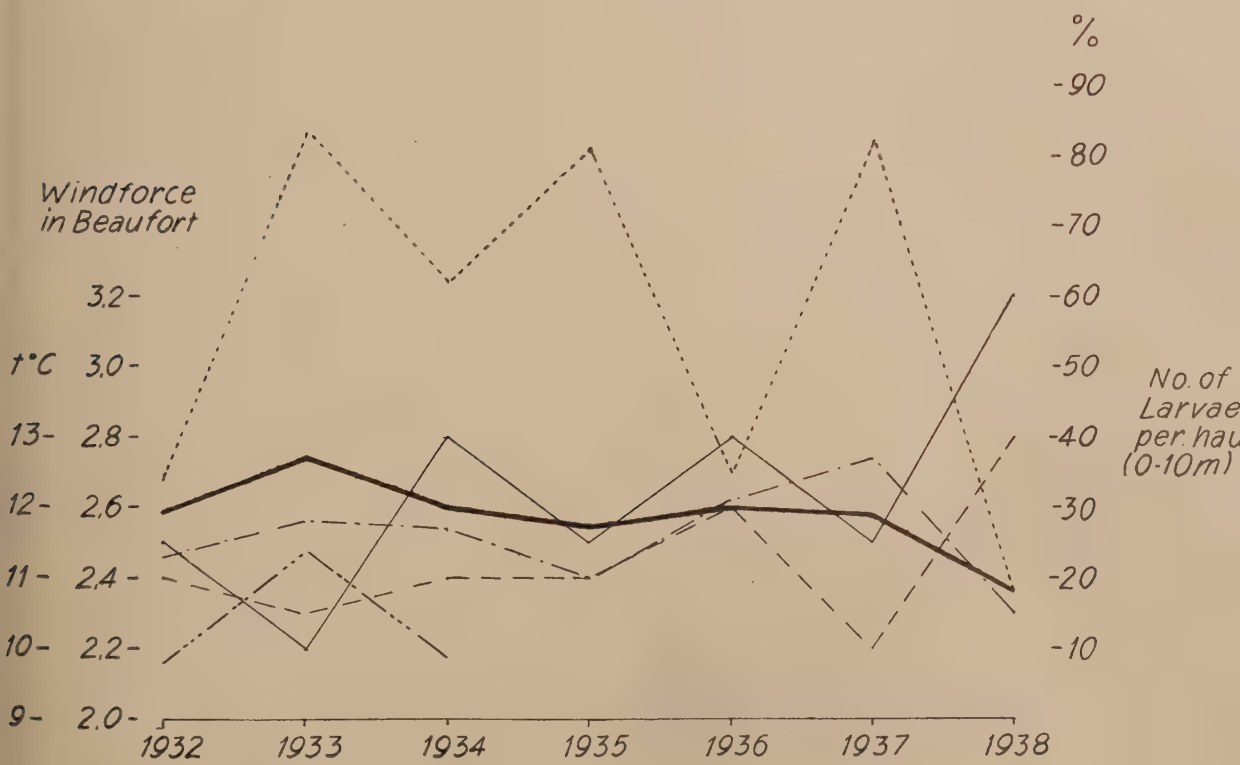


Fig. 3.

——— The mean force of wind during April—July at Vinga L. V.
— — — The mean force of wind during April—July at Fladen's light-vessel.
- - - - - - - The percentage contribution of the I-Gr. to the stock of the Skerries.
——— The mean temperature of the surface during April—July.
· – · – · The air temperature during April—July.
·–·–·–·–·–The number of larvae per haul 0—10 m. at 35 stations, 1932—1934.

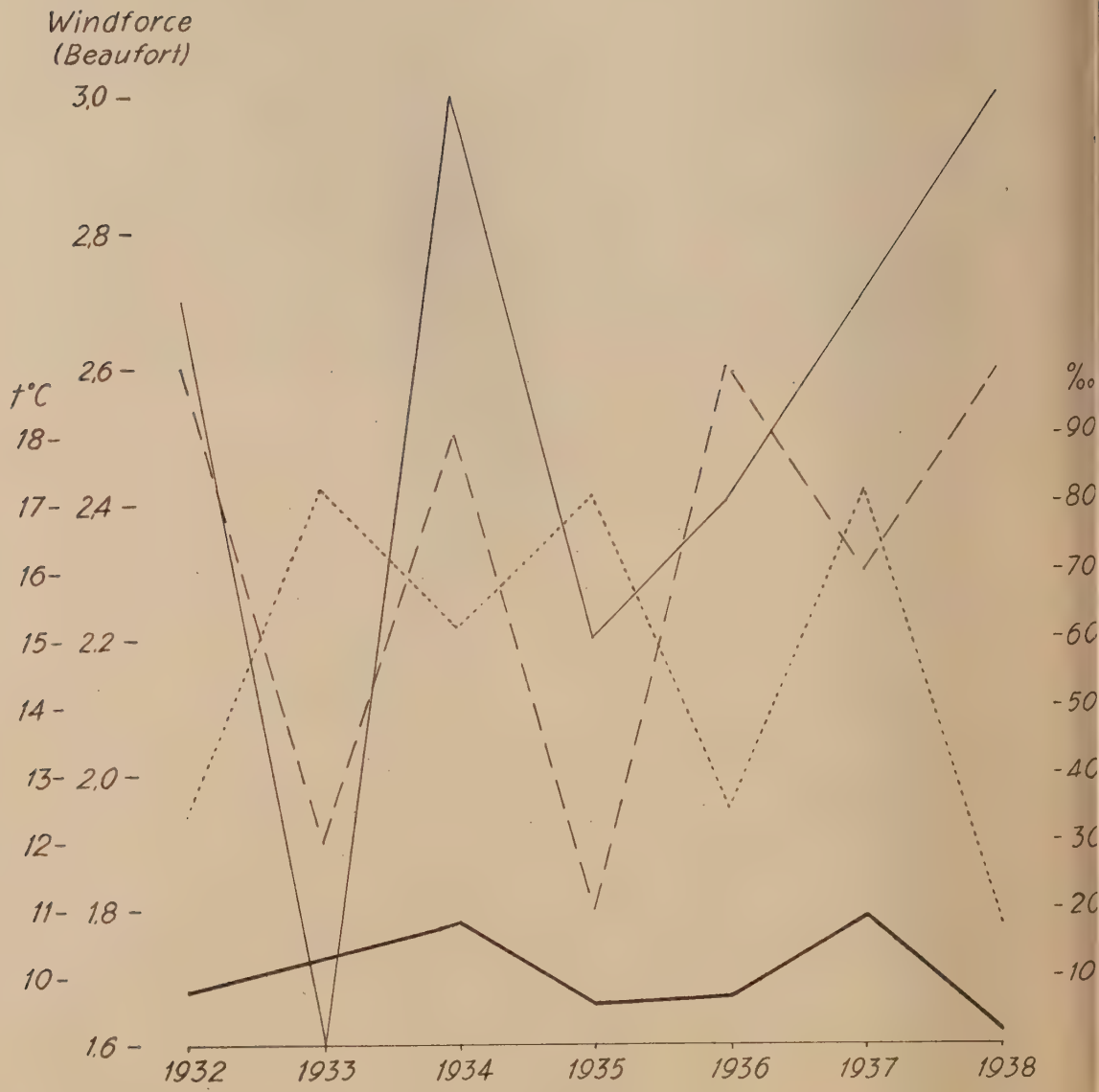


Fig. 4.

———— The average force of wind (in Beaufort) during May at Vinga L. V.
— — — The average force of wind (in Beaufort) during May at Fladen L. V.
--------- The strength of the yearly appearing year-class off the Skerries, as it appears as I-Gr. the following year.
———— The mean value of the surface temperature in May.

Nolander, 1940). Is is undoubtedly competition for food in the strong year-classes which has reduced the growth of the single fish. It may also happen that the II-group in a stronger year-class has a weaker growth. Many examples of this sort of variation in growth in connexion with the changing strength of the year-classes have also been reported in earlier investigations (Molander, 1940).

It might certainly be disputed whether the competition for food within a certain year-class may be the sole reason for the differences in growth found in different year-classes. The growth-types themselves certainly develop in the hydrographical milieu in which the sprat lives, but it can hardly be possible to trace any direct connexion, in normal cases, between the variations of growth in the different year-classes and the generally rather insignificant differences which separate the hydrographical milieu of one year from that of another (Tab. 3). It is well conceivable that, e.g., higher temperatures in the upper water layers during spring and summer may have some accelerating influence on the growth, but as a rule it is not possible to prove any noticeable agreement between the hydrographical data and the difference in the yearly growth, by which the year-classes diverge from one another. In a rich year-class one frequently finds a reduction of growth not only during the first and second growth-period, but also continuously or as long as the relevant year-class is represented in a numerically rich stock, even if hydrographical conditions should have changed during that time (cfr. Figs. 3—4).

It has been proved that very exceptional hydrographical conditions really can effect the growth directly. A striking example hereof is presented by the very long and hard winter of 1940. In Table 6, I have entered the figures of the temperatures from a station in the Koljefiord, that was investigated in different years during the period May to July. Most observations were made in the years 1935 and 1940, and they have been entered in Table 6 together with similar observations from the year 1937. The sprat spawns to a considerable extent in the Koljefiord as well as in the other Uddevallafiords (Höglund, 1938).

A glance at Table 6 as well at Fig. 9 shows a remarkable difference between the temperature figures for spring and summer of 1940 — especially at 10 and 20 m. depth — and for the same seasons in 1935 and 1937.

In this connexion it is worth mentioning that in

Table 4.

The Average Length of Sprat from the Open Sea arranged in Age-Groups I—IV according to Years (1934—1939) and Year-Classes (1933—1938).

Year	Age-Groups I	II	III	IV	Year-Class	Age-Groups I	II	III
	cm.	cm.	cm.	cm.		cm.	cm.	cm.
1934	12·1	13·3	—	—	1933	**12·1**	**13·4**	**14·6**
1935	12·6	13·4	—	—	1934	12·6	13·6	14·4
1936	**11·9**	13·6	14·6	—	1935	**11·9**	**13·5**	**14·5**
1937	12·3	**13·5**	14·4	—	1936	12·3	13·9	14·6
1938	**12·0**	13·9	**14·5**	—	1937	**12·0**	**13·4**	—
1939	12·2	**13·4**	14·6	15·4	1938	12·2	—	—

Table 5.

The Average Length of Sprat from the Uddevallafiords arranged in Age-Groups I—IV according to Years (1936—1939) and Year-Classes (1935—1938).

Year	Age-Groups I	II	Year-Class	Age-Groups I	II
	cm.	cm.		cm.	cm.
1936	**11·06**	11·84	1935	**11·06**	**12·22**
1937	11·40	**12·22**	1936	11·40	12·53
1938	**10·85**	12·53	1937	**10·85**	**11·90**
1939	11·37	**11·90**	1938	11·37	—

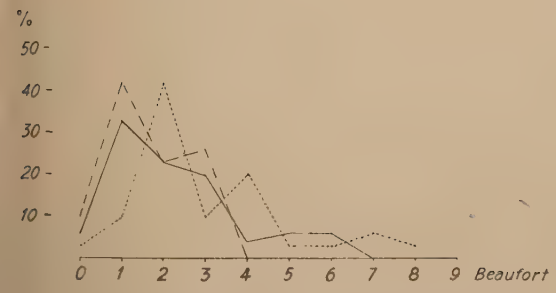


Fig. 5. The percentage occurrence of different wind forces during May, counted in number of days.
———— 1932; — — — — 1933; ····· 1934.

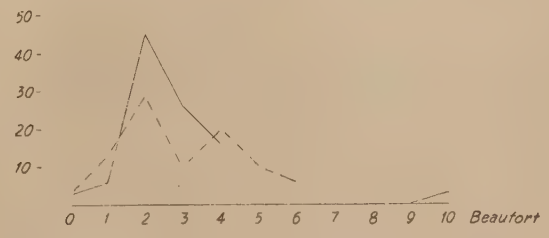


Fig. 6. The percentage occurrence of different wind forces during May, counted in number of days.
———— 1937; — — — — 1938.

Fig. 7.

——— The mean length of sprat of the I-Gr. caught off the Skerries during 1938—1939.

- - - - - - - - The percentage contribution of the I-Gr. during the same time.

the autumn of 1940 the year-class 1939, i.e., that which formed the mainstay of the stock in 1940, was unusually weak, and this was especially noticeable in the Uddevallafiords. As has been said above the I-group generally constitutes the principal part of the catches of sprat, and a strong I-group thus means a good yield of the fishery. The yea class 1939, however, was very weak, which i.a. w noticeable from the poor fishery of the autum 1940.

A strong growth had therefore been expect instead of the marked weak one which w experienced in all the Uddevallafiords. The sca of the sprat (Fig. 8) from the Koljefiord and t other fiords I have examined, also showed a ve weak growth for the growth-period of 19 compared with the corresponding growth of, e. the year 1935. In Table 7, I have entered so explanatory figures for the growth during the fi and second growth-period (the first and second su mer of various samples) of sprat from the Uddeval fiords from September, 1935, and from August a October, 1940. From this it can be seen that duri both years the first growth was rather similar (7 7·8 and 8·1 cm. resp.). The second summer grow of the sprat of 1940, however, averaged only 1·8 a 2·0 cm. against 3·4 cm. in 1935. In Fig. 9, I ha entered curves for the temperature figures at and 20 m. depth in 1935 and 1940 and in Fig. the average growth of the first and second summ of sprat from the years 1935 and 1940.

During the long and hard winter of 1940, sea water had been cooled more than usual, it is very striking that this cooling had an eff right up to the summer and during the months w the strongest growth of the sprat normally ta place. The low temperature of the sea water probably delayed and restrained the metabolism

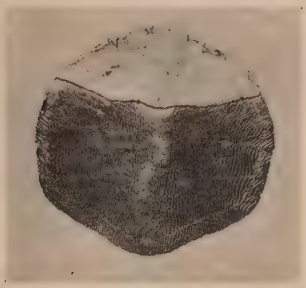
Table 6.

Temperatures from the Station Koljefiord (58°14·2′N., 11°35·1′E.) in May—July, 1935, 1937 and 1940

Year	Depth m.	Date 14/5	31/5	1/7	Year	Depth m.	Date 4/5	5/7
1935	0	9·90	13·00	18·60	1937	0	11·50	19·29
	5	—	—	19·04		5	5·40	16·67
	10	9·60	12·70	13·20		10	3·50	16·40
	20	5·80	5·90	5·70		20	6·23	5·65
	30	5·90	5·85	5·70		30	5·65	5·13
	38	5·25	5·70	5·65		38	5·21	4·96

Year	Depth m.	Date 13/5	24/5	31/5	7/6	14/6	20/6	28/6	6/7	12/7	1
1940	0	9·95	13·70	15·10	15·45	16·95	18·20	18·50	17·49	19·00	19
	5	9·90	11·22	13·10	14·38	16·40	17·78	17·88	17·25	19·85	19
	10	2·10	2·00	2·73	3·80	3·40	5·65	3·60	3·63	4·68	16
	20	0·40	0·40	0·47	0·60	0·62	0·60	0·70	0·70	0·45	1
	30	0·40	0·40	0·38	0·50	0·50	0·55	0·60	0·65	0·65	0
	37	0·50	0·50	0·50	0·60	0·60	0·68	0·60	0·60	0·70	0

a



b

Fig. 8. Scales of sprat from the Uddevalla fiords (I-Gr.), 17/9 1935, (a), 11·5 cm. and from 15/8 1940, (b), 8·5 cm. (Höglund phot.)

Table 7.

Sprat from the Uddevallafiords belonging to the I-Groups of the Year-Classes 1934 (27/9, 1935) and 1939 (15/8, 1940 and 29/10, 1940) and their Growth-Increment (in cm.) during the first and the second Growth-Period (t_1, t_2).

27/9 1935				15/8 1940				20/10 1940			
No.	Size	t_1	t_2	No.	Size	t_1	t_2	No.	Size	t_1	t_2
1	11·5	6·9	4·6	1	8·5	7·4	1·1	1	10·0	7·9	2·1
2	11·5	7·4	4·1	2	9·5	6·7	2·8	2	10·5	6·7	3·8
3	10·5	6·9	3·6	3	10·5	8·7	1·8	3	11·5	7·2	4·3
4	11·0	9·1	1·9	4	10·0	7·8	2·2	4	10·5	9·0	1·5
5	11·0	7·9	3·1	5	9·5	6·5	2·0	5	10·5	8·7	1·8
6	11·0	7·9	3·1	6	9·5	8·3	1·2	6	10·0	8·8	1·2
7	11·5	7·8	3·7	7	9·5	7·7	1·8	7	10·5	8·9	1·6
8	11·5	7·6	3·9	M.	9·6	7·8	1·8	8	10·5	8·6	1·9
9	11·5	8·0	3·5					9	10·0	7·7	2·3
10	12·5	8·4	4·1					10	9·5	8·4	1·1
11	12·0	9·9	2·1					11	10·0	8·8	1·2
12	12·0	8·0	4·0					12	9·0	7·4	1·6
13	10·0	6·1	3·9					13	10·5	5·6	4·9
14	11·5	7·2	4·3					14	10·0	7·8	2·2
15	11·0	8·0	3·0					15	11·0	7·6	3·4
16	12·0	8·4	3·6					16	10·0	8·8	1·2
17	10·5	5·5	5·0					17	10·5	8·1	2·4
18	10·5	4·5	6·0					18	11·0	8·7	2·3
19	11·0	7·8	3·2					19	10·5	8·7	1·8
20	11·5	7·9	3·6					20	9·5	7·9	1·6
M.	11·3	7·6	3·7					21	10·0	9·3	0·7
								22	11·0	8·4	2·6
								23	9·5	7·9	1·6
								24	9·5	7·3	2·3
								25	10·0	7·9	2·1
								26	9·0	7·8	1·2
								27	10·5	8·1	2·2
								28	10·0	7·7	2·3
								29	10·0	8·4	1·6
								30	9·5	8·1	1·4
								M.	10·1	8·1	2·0

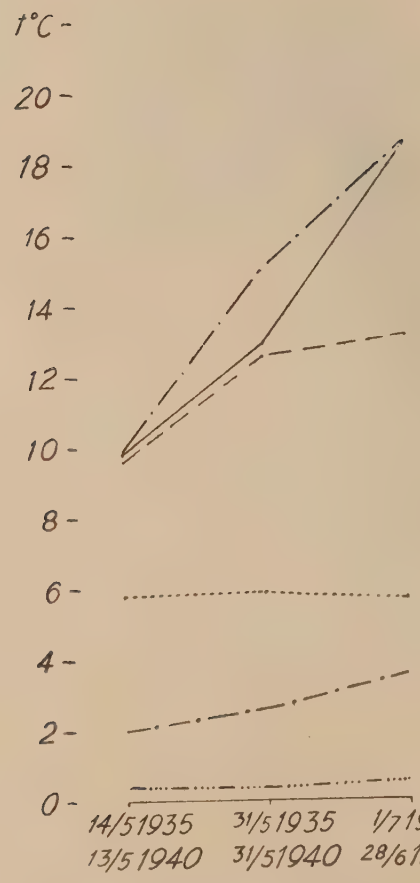


Fig. 9. The temperature during May—July at the station Koljefiord, 1935 and 1940, at 0, 10 and 20 m. depth.

1935 1940

0 m. ———— -·—·—·—
10 m. — — — — — -·-·-·-·-
20 m. - - - - - - - - - - ·····

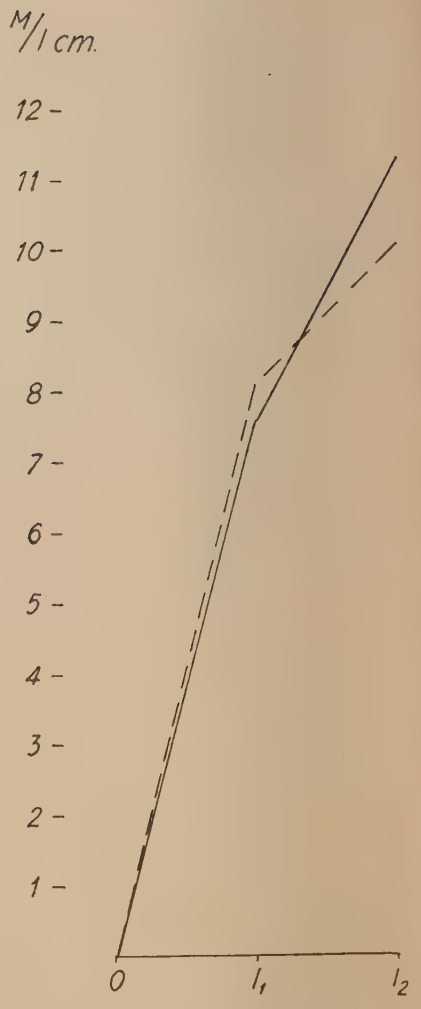


Fig. 10. The mean size after the 1st (l_1) and the 2nd (l_2) growth-period of sprat.

————September 1935; — — — — —October 19

the sprat (cfr. Sund, 1911) so that the growth started much later than usual. The growth was even weaker than that usually effected by a strong competition of food within a rich year-class. The weak growth during the summer of 1940 is not only significant for the sprat from the Uddevallafiords, but is also found with sprat from other fiords in Bohuslän and with the sprat from the area off the Skerries. Most striking is this restrained growth of the sprat in the fiords and the archipelago of Bohuslän.

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Baltic Area.

nmark.

From the Danish Biological Station.

Director: Dr. H. Blegvad.

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ice.

Number of 0- and I-group-plaice caught in 39 off the east coast of Sjælland, Møen and lster. (Johansen-trawl, 30-min. haul.)

	0-Gr.	I-Gr.	No. of Stat.
1935	6	6	12
1936	3	7	10
1937	1·6	0	5
1938	8	0	8
1939	0·8	0	10
Mean of 1927—39	4	1·8	

Number of anal-fin rays in 0-group-plaice from e coastal experiments 1939, SE. of Falster-Møen.

No. rest.	Anal-fin mean	σ	σ_m	σ_σ	Mean Anomalies 1928—38
7	50·7	1·55	0·59	0·41	+0·9

Number of the various age-groups of plaice ught per 5-hour haul with eel-tog, 1st Oct. 1938 - 30th Sept. 1939.

pth-Zone:	1—14	15—34	> 34 m.
0	—	—	—
I	30	7	1
II	6	0·3	—
III	—	0·1	0·2
IV	—	0·4	0·4
V	—	0·7	0·4
VI	—	0·1	—
VII	—	—	—
VIII	—	—	—
IX	—	—	—
X	—	0·1	—
No. of Stat.	5	15	11

Herring.

Age- and race-analysis of Baltic autumn herring, 1st Oct. 1938 — 30th Sept. 1939.

		W. of Bornholm 30/6-6/7-12/8	E. of Bornholm 4/7-8/8-10/8-11/8	E. of Sassnitz 14/8
		Drift-net	Drift-net	Trawl
Total No.		279	557	172
Size, cm.		14-25	18-28	13-28
V. S.		55·42	55·41	55·38
(No. of ind.)		(92)	(128)	(94)
Maturity (Total Range of Mat.)		III-IV (II-VIII)	IV-V (II-VIII)	III-IV (II-VIII)
Age-Distribution, Percentage	2	86	14	27
	3	12	13	31
	4	1	22	15
	5	1	15	9
	6	—	13	10
	7	—	11	4
	8	—	8	1
	9	0·4	3	2
	10	—	1	—

V. S.: Total number of vertebrae. Maturity (acc. to the scale of Johansen): maturity of main part of the sample, in brackets, total range of maturity in the sample.

The herring fishery at Bornholm gave this year very small results. The fish were generally very small and 2—3 years old. No doubt some poor year-classes had been responsible, at least partly, for the failure of the fishery, but investigations as to the number of larvae from the different years have not been carried out and regular investigations of the age composition of the stock fished are not available.

Average length of herring of the different age-groups in commercial catches, July—Aug. 1939.

Age, Years	W. of Bornholm Drift-net	E. of Bornholm Drift-net	E. of Sassnitz Trawl
2	15·85 (242)	14·76 (75)	16·40 (47)
3	16·83 (29)	18·94 (71)	18·69 (54)
4	18·5 (4)	20·47 (121)	19·76 (26)
5	19·0 (3)	20·60 (86)	22·2 (15)
6	—	20·88 (73)	21·9 (7)
7	—	21·07 (60)	22·0 (7)
8	—	21·33 (46)	21·5 (2)
9	—	21·61 (18)	24·5 (4)
10	—	22·4 (5)	—

In brackets: number of herring.

At Bornholm the size of the herring of the various age-groups was generally smaller west of the island than to the east, which may correspond with the fact that the amount of food was most scarce in the western region.

The length of the age-groups — especially of those of 5 years and older — was larger at Rügen corresponding may-be to the fact that the state of nourishment here was better than at Bornholm.

ıden.

Investigations on the Baltic Herring.

By

Harald Alander.

THIS paper, which is primarily based on the material collected during later years by the research vessel "Eystrasalt" intends to give cture of the age-distribution of the stock of ng in the Baltic during 1942. Owing to the mstances it has not been possible to carry out nvestigations during later years to any extent oaching normal conditions. Thus considerable of the Baltic have been barred to all in- gations for long periods. It is, therefore, dered best not only to include investigations recent years but also some material from the eding ones in order to give a fuller picture of onditions.

he area under investigation covers the waters de the Swedish coast from the neighbourhood imrishamn in south to the Ulvöarna in north. ng the treatment of the material it has proved ical to make a regional division of the area. samples collected outside Simrishamn and as well as at the southern part of Öland how a very great conformity; those from the Oskarshamn—Häradsskär—Hävringe deviate ome extent from the first named group but e a good conformity *inter se*. The samples cted off Gävle, Agö and Ulvöarna similarly a third group.

he samples are generally taken by nets; in w cases only samples are taken from trawl es. Nets have a certain influence on the osition of the catches, inasmuch as the sizes ht are generally related to the mesh-width used. der as far as possible to eliminate this selective ence of the gears a whole series of nets uring from 11 to 21 mm. from knot to knot have used during the investigations, but all the same atches are not absolutely representative of the present. It is for instance seldom that the ummer herring is contained in the catches, and it is doubtful if the catches of two-summer herring even can be considered as fully representative of the real composition of the stock. In this connexion I beg to refer to the investigations made by K ä n d l e r (Monatshefte für Fischerei, Nr. 2, 1942) on the herring in the western Baltic, where he has been able to follow the several year-classes from their first appearance as one-year-old herring through samples of catches with "Tuckzeesen". The conditions in the Baltic, however, are such that in a very few areas only fishery can be made with other gear than nets. The way of fishing, though, does not play any important part in respect of older year-classes. A few samples, given below, taken off Simrishamn in the autumn, 1942, one by net, the other by trawl, show no particular deviations. It may be assumed, therefore, that the samples collected give a fairly true picture of the actual conditions.

The autumn-spawning herring seems to have predominated in the Baltic during recent years, while the spring-spawning herring, the Skærgårds-regions not included, have played a lesser part. The samples treated here belong — if nothing else is said — to the autumn-spawning herring.

During the first half of the thirties it was especially the rich brood from 1929 which dominated in the stock of autumn-spawners in the Baltic and formed the main part of the catches for a series of years. The autumn-spawning herring had some poor brood years during this period, and the stock, therefore, did not get any real new recruitment until after the middle of the thirties. This new recruitment of brood seems to have culminated in the year 1937 in the whole of the Baltic, but the culmination seems to have had a somewhat different course in the several parts of the Baltic.

Depth-Chart of the Baltic.

Age-Composition of Herring.

Table 1.

ıthern Baltic.

Locality of Catch	Age 1	2	3	4	5	6	7	8	9	10	11
nö, Nov. 1939	0	101	19	8	5	1	3	4	3	0	—
of Kalmar, Oct. 1940	0	4	67	17	3	2	1	2	0	2	0
nö, Oct. 1940	1	5	56	17	6	6	4	1	0	4	0
mrishamn, Oct. 1940	0	1	74	21	3	0	1	0	—	—	—
mrishamn, June 1941	0	8	84	6	2	0	—	—	—	—	—
mrishamn, May 1942	0	4	20	111	36	7	3	0	—	—	—
nö, Aug. 1942	0	5	9	17	51	11	6	1	0	—	—
mrishamn, Aug. 1942 (net-caught-herring)	0	0	0	4	36	3	0	—	—	—	—
mrishamn, Oct. 1942 (trawl-caught herring)	0	0	2	18	129	6	2	0	1	1	1

Table 2.

iddle Baltic.

Locality of Catch	Age 1	2	3	4	5	6	7	8	9	10	11	12
E. of Hävringe, end of July, 1940	0	5	33	23	11	7	3	5	4	3	5	1
NE. of Oskarshamn, Sept., 1940	0	6	30	28	12	5	2	2	4	6	5	0
Häradsskär March, 1942	0	1	3	71	16	4	3	0	1	1	0	—
NE. of Oskarshamn, May, 1942	0	0	6	45	27	6	7	3	3	2	1	0

Table 3.

liddle Baltic.

Locality of Catch	Age 1	2	3	4	5	6	7	8	9	10	11	12
Norra Midsjöbanken, June, 1940												
spring-spawners	0	0	0	0	0	1	1	8	18	7	1	0
autumn-spawners	0	7	4	0	0	0	1	1	1	0	—	—

Table 4.

otten Sea.

ocality of Catch	Age 1	2	3	4	5	6	7	8	9	10	11	12	13
ägö, Aug., 1939	0	15	93	40	8	7	3	2	3	25	3	1	0
öregrund, Aug., 1940	0	47	14	18	4	2	2	4	0	—	—	—	—
ägö, Aug., 1940	0	3	70	120	51	13	7	7	12	8	4	3	2
Ulvöarna, July,1942	0	0	1	10	33	30	13	5	3	4	0	0	1
ägö, July,1942	0	0	3	10	42	29	6	2	2	4	2	0	—
E. of Gävle, July,1942	0	0	2	11	25	29	13	8	5	4	2	0	1

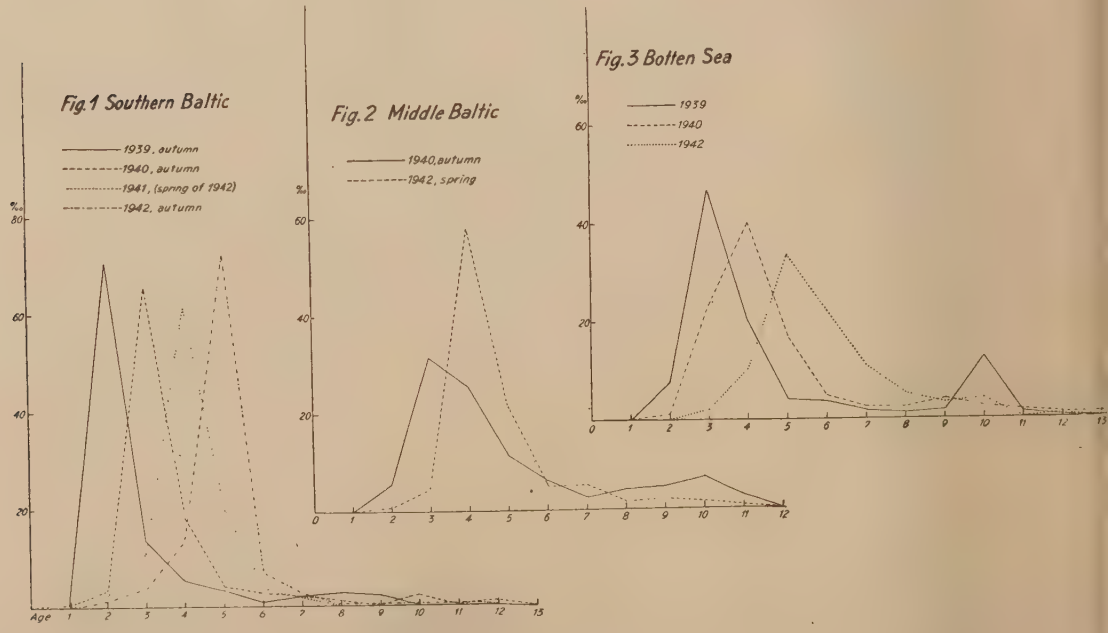
In the **southern Baltic** a few relatively poor year-classes predominated, as the old stock of large herring disappeared. In late summer and autumn 1939 a sudden change in the situation happened as great quantities of small herring appeared off the coast. Investigations proved that this herring belonged to the brood hatched in the autumn of 1937. During the following years the catches generally consisted of this herring which grew larger and larger year by year. The number of individuals of the various year-broods in the catches is given in table 1. The relative distribution of the year-classes in some representative catches is shown in Fig. 1. In the diagram catches are shown generally from the autumn season in the respective years. As, however, some samples from the autumn of 1941 could not be procured values have been inserted from catches taken in the spring of 1942, and so early that the summer increase could not influence the age determination.

The table and the diagram clearly show how one single year's brood has been able to dominate the catches during a series of years. If the recruitment of the stock is not particularly bad, such a brood's numerical strength will show a marked decrease. As no such decrease has taken place during later years the recruitment may be considered especially poor during the years after 1937.

As regards the **middle Baltic**, i.e., the regio Oskarshamn—Hävringe, it must be pointed out th the herring fishery here is not based on the se herring stock to the same great extent as is t case in the southern Baltic. In certain regions the Skærgård there is an important fishery f spring-spawning fjord-herring. The catches table 2 and in Fig. 2, however, are composed autumn-spawning sea-herring.

As compared to the conditions in the southe Baltic it seems evident that the 1937 year-class d not fully dominate the catches. The 1937 ye class did not appear until 1940 — probably d to the fact that the herring in the middle Bal does not grow as quickly as that in the south Baltic and in 1942 only, when the 1936 year-cl was thinning out, it can be said that it rea dominates the stock. It is regrettable that it not been possible to get a larger amount of samp from this region on account of the mine-fields.

In June 1940 some investigations took place the Norra Midsjöbanken and even herring samp were then taken. Unfortunately it has not b possible owing to the conditions to make a r sampling in this region, and thus more fargo conclusions cannot be drawn from the samples. spring-spawning herring was spawning during sampling, a fact that must also be considered w



Figs. 1—3. Relative Distribution of Year-Classes.

ig this sample. In the upper line of table 3 en the number of spring-spawners, and in the one the number of autumn-spawners in the e.

is of interest, however, to note that the on between the 1936 and the 1937 year-brood most the same as in the middle Baltic at the time. The great number of old spring-ners also is of interest. This state of affairs possibly be interpreted as the older year-s' tendency to gather rather far from the , but may also be a token of an occasional ecruitment of the stock.

he recruitment in the **Botten Sea** seems not to been limited to one or two years as the case been in the southern and middle Baltic, and nalogy to the sudden appearance of the 1937 class in the southern Baltic can be mentioned. ng the later part of the thirties and the early es the fishery was based on a sequence of ively good year-broods. Unfortunately not y samples exist from this area, the samples n in 1942 which have been mentioned here are n when the year-growth had already resulted new summer-ring on the scale. The 5-year-old ring in the samples taken in 1942 must, there-, be considered belonging to the 1937 year-od. Table 4 and Fig. 3 show the conditions in stock of herring 1939—1942 in the Botten Sea. With the exception of the sample taken at Öre-nd, the samples show a relatively good agree-nt and thus they can be considered as giving a ner true picture of the actual conditions. The sample from Öregrund contains about 50 % two-year-old herring hatched in the autumn of 1938. As this year-class — according to the other samples — was not so rich as the nearest preceding one their appearance must be taken as an occasional over-representation. In Fig. 3 this catch, therefore, has not been taken into account. In the samples taken in 1939 a distinct remainder of the rich brood from 1929 is still found. In the samples from the middle Baltic this can still be traced in 1940 whereas it seems to have played out its part earlier in the southern Baltic. Of later broods those from 1936 and 1937 are dominant, but none of them dominate to such an extent as the 1937 year-brood did in the southern and middle Baltic. It is interesting to see how this brood in the Botten Sea does not gain the upper hand over the nearest preceding broods until 1942. In the catch taken east of Gävle the 1936 year-class is still dominating, and thus it cannot definitely be said which of these two has been the stronger one. The results published here as a whole give the impression that the recruitment of the herring stock in the Botten Sea has followed a more adjusted curve than in the other parts of the area investigated — at any rate during later years. It is, therefore, to be expected that the curve will decrease smoothly after having passed maximum, and the somewhat weaker 1938 year-brood gives a certain hint in that direction. But after this year it seems as if the recruitment has been just as bad as in the southern and middle Baltic.

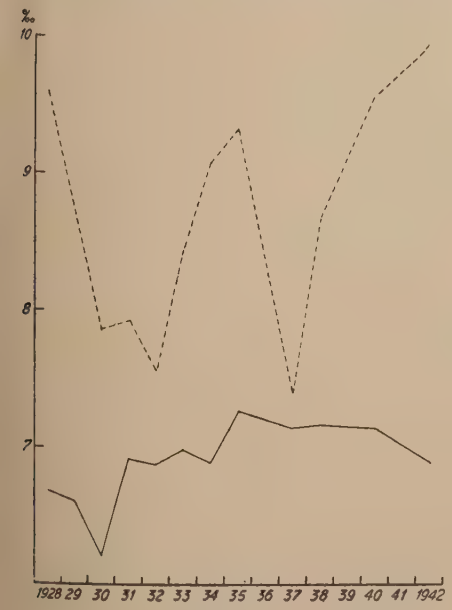


Fig. 4. Salinity W. of Gotland.
———— 20 m. - - - - - - 70 m.

It would be of interest to know what factors determine whether a stock of herring shall be good or bad. A simple and direct relation between the size of the broods and the prevailing hydrographical conditions is not easy to show, but no doubt a certain relation does exist. The herring must, however, be considered rather resistent to changes in the salinity, and as it seems as if good and bad brood-years appear in a homogeneous rythm in the whole of the area of investigation with its extremely different hydrographical conditions the reasons cannot rightly be sought in these. Some diagrams are added showing some data from the late summer at certain stations investigated during the years 1928—1942. In Fig. 4 showing the salinity in the middle Baltic west of Gotland at 20 and 70 m. depth a certain agreement is found between low salinities at 70 m and good brood-years. This is quite astonishing. The herring spawning takes place in considerably shallower water, but any relation between good and bad brood-years on one side and the salinity-curve for 20 m. can hardly be traced. There is still less agreement when the conditions in the Botten Sea are considered; these will be seen from Fig. 5. As there has been a marked decrease in the supply of brood in the Botten Sea since 1938, and at the same time an increase in the salinity, a relation between high salinity and bad brood-years might possibly be found but this is perhaps apparent only and totally due to circum-

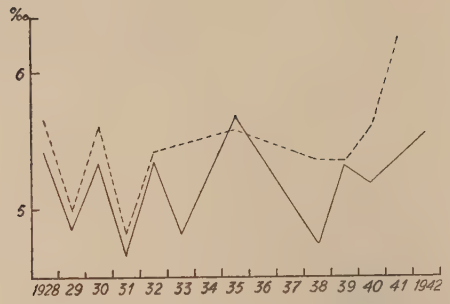


Fig. 5. Salinity off Agö.
———— 20 m. - - - - - - 50 m.

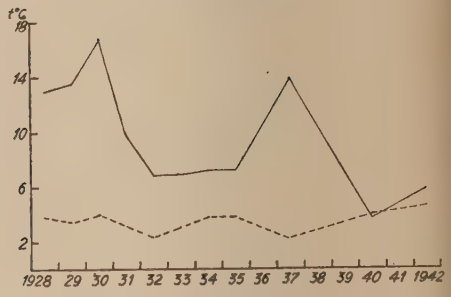


Fig. 6. Temperature W. of Gotland (July—Sept.).
———— 20 m. - - - - - - 70 m.

stances. On the other hand there might be found a more conspicuous and perhaps even more true relation between the temperature at 20 m. and the production of brood. As will be seen from Fig. 6, showing the temperature in the middle Baltic during the years 1928—1942, there is a certain relation between the good brood-years and the relatively high water temperatures at the surface. Perhaps there might be a certain co-operation between temperature and salinity. A high water temperature due to abundant insolation is naturally favourable to the plankton production. If the difference in salinity between the bottom water and the surfa water has been relatively small during a previc colder season a certain readjustment of the lay has made material important to the plankton p duction rise from the deeper layers. As the herr brood, as is well known, during certain peri of development is especially dependent on cert plankton species, it is not improbable that the h mentioned coincidence between good brood-ye and low salinity in the deeper layers together w a high temperature in the surface layers rea expresses an actual causal connexion.

Salmon and Trout Committee.

A Method of Comparing Statistics on Variations in the Catch, especially in Salmon Rivers.

By

Eyvind Dahl and **Knut Dahl.**

FOR some years the authors have been occupied in the joint work of studying the statistical data pertaining to the salmon rivers of rway. One of us, K n u t D a h l, has supplied extraction of the statistical data from each of 151 salmon and sea trout rivers of Norway, l the other collaborator, E y v i n d D a h l, has n occupied in the graphic treatment of the sta- ical data.[1])

In the course of our work we had occasion to mpare the data from various rivers in order to if any obvious similarity was noticeable in the e and fall of the yield in such rivers.

In order to do this it is imperative to be able compare the data in such a form that the dis- nilarity in the actual yield of the several rivers ıy be neglected, and the rises and falls in yield ıy be judged by the same standard. Now in aphical representations of this kind one does as rule resort to the procedure of choosing a certain an of years, in the first part of the period covered the statistical data, say 10 years, and calculating average for these years, record the yield for ch separate year of the whole period in percent- es of this average yield.

In choosing this average yield as a standard for mparison, grave errors may however occur, as possible variations in the chosen period may ry largely, and may possibly, and in many cases rely. not be of equal value as a standard for the er for purposes of comparison with other rivers.

One of us, E. D a h l, therefore suggested that stead of choosing the average for the first 10-year period as a standard, the *standard to be chosen should be the highest yield of the river.*

In choosing this standard and recording the annual yield in percentages of the best year of the river, we should obtain a percentage curve telling us when the river had been at its best and whether it had deteriorated and then again improved. And by this method we should obtain a means of comparing the results from fishing in various rivers irrespective of the actual magnitude of the yield. It would tell us quite plainly if the catch of the various rivers had deteriorated or improved, and to what degree this had taken place and whether the rises and falls had been simultaneous, all judged by the simple standard of the maximum yield in each river.

As this theory seemed worth studying E. D a h l made the necessary calculations for some few rivers, which at the time avoke our interest, and as the results seemed very promising we resolved that the statistics from all the salmon rivers in Norway should be treated in the same manner and the resultant graphical representations be drawn up. This laborious work was undertaken by E. D a h l and has now been finished, the results being very satisfactory and to our mind obviously of great importance for the future judgment on the state of Norwegian salmon rivers.

For the purpose of this article however, which is to point out the general interest which to our mind attaches to the method, and which may offer some inducement to treat also other fishery statistics in a similar manner, we will only give a few examples with the necessary comment.

First of all we have treated the statistics of the total yield of the Norwegian salmon fisheries on

[1]) K n u t D a h l og E y v i n d D a h l: Norges Laksefiske- er. Landbruksdepartementet, Oslo 1942.

the above principle, representing the yield in annual percentages of the record year for the period (1880—1938). This percentage curve has been represented in Fig. 1.

Observing the course of this curve we note that variations have occurred, but we also note that there is no sinking tendency in the reported yield of the salmon fisheries of Norway. On the contrary, the maximum yield occurred as late as in 1926 and still keeps very high. From the representations from rivers which we have drawn up we will now record only a few, which demonstrate some of the extremes and as it were typical conditions which pertain to the salmon rivers of Norway.

Comparing the curve in Fig. 1 with Figs. 2 and 3 which represent two salmon rivers of southern Norway, we find a very striking difference from the curve for the total salmon catch. The M a n d a l (Fig. 2) used to be one of our best salmon rivers, the annual catch running into 34,709 kg., and the F e d e (Fig. 3) is an insignificant small river the catch in the best year running into 561 kg. But both rivers become comparable by the method employed and both show the same deviation from the total curve for the salmon fisheries. Both rivers show an enormous decline in the catch. As to the reason for this enormous difference the method can give us no solution; but the method becomes an instrument that in a very precise and instructive form raises the problem: why this enormous difference? Fig. 1 shows that a decline in the total yield has not occurred. Why is it that the two rivers represented in Fig. 2 and Fig. 3 follow quite another curve. We immediately get the impression that there must be something in the conditions in the rivers themselves which is instrumental in causing this marked difference from the conditions in the country as a whole, a difference which is common to most of the rivers of south-western Norway. These conditions cannot be understood without a thorough investigation, and although we have some knowledge as to the special conditions which obtain in these south-western salmon rivers of Norway, it is for one thing too early, and secondly not imperative to enter into such discussion here. We only wish to point out that the method employed in treating the statistical data and rendering them comparable is a suitable means of raising the problems mentioned above.

Taking the L æ r d a l river represented in Fig. 4 and comparing that curve with the curve in Fig. 1 we at once notice that although the variations are not of equal magnitude in the two curves, they show so far a similarity, as the Lærdal has by no means deteriorated. If possible the course of the curve is even more favourable than the total curve in Fig. 1 and the comparison tells us that the Lærdal has not deteriorated, although the approach to this river, through the very long Sognefjord, which is full of fishing engines, is very dangerous, and where by marking experiments we have record percentage of recapture of 71 %.[1])

Surely here the method employed gives u means of comparison which will be of great in judging the wisdom of the management of Lærdal river.

Going to the next extreme we will compare total curve for Norway Fig. 1 with that for V e r d a l river, which runs into the innermost of the Trondhjem Fjord, see Fig. 5.

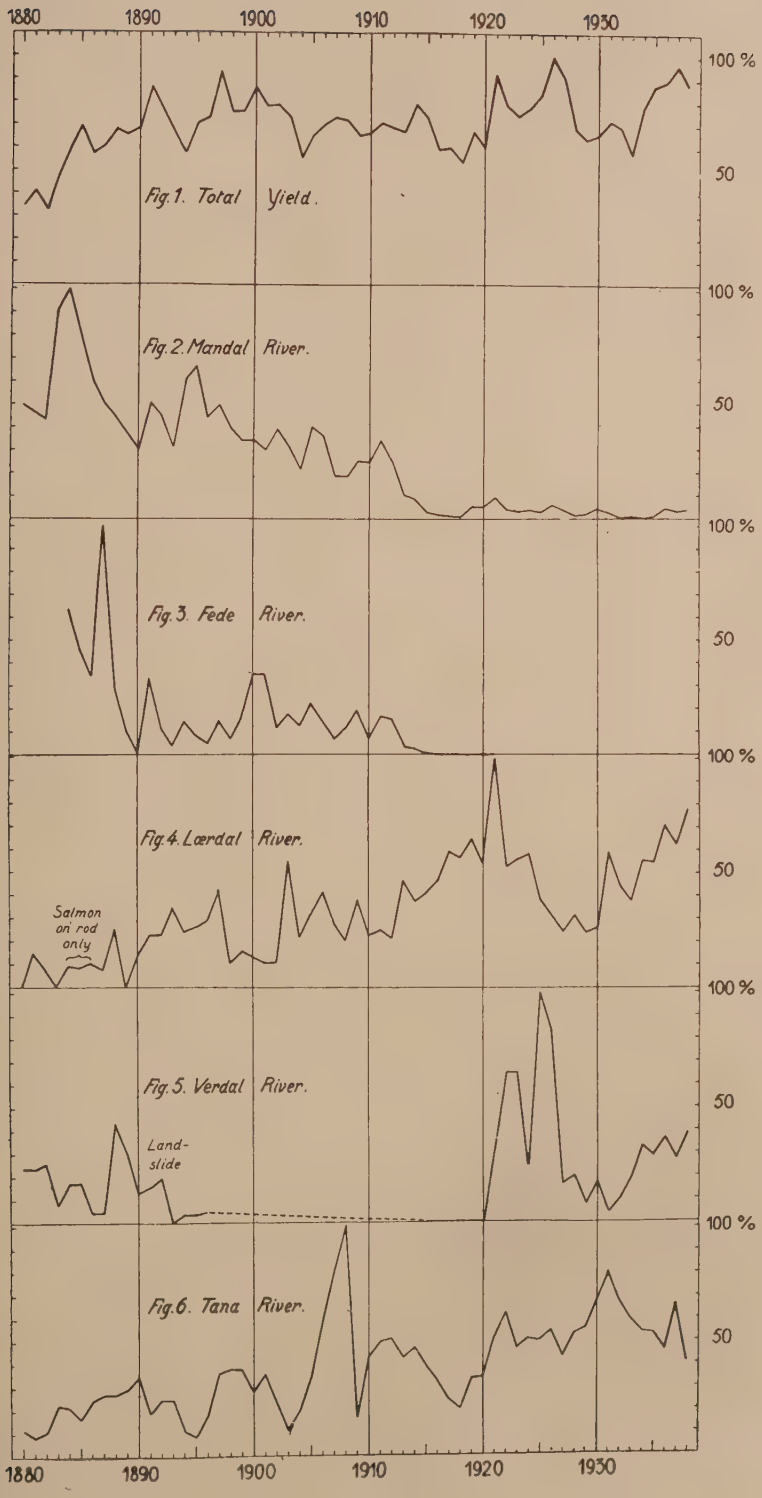
The Verdal used to be a fairly important ri the catch lately having amounted to 2,190 kg. In 1893 a tremendous landslide swept out the ri destroying fish, alevins and parr along the r course of the river and rendering it unfit lasting abode for salmon. And after this cala salmon were reported as taken only for 3—4 y corresponding to the 3—4 groups of immature that were in the sea and had to enter in subseq years. But from that time and until 1920 n fish was reported as captured.

One of the tributaries, to which salmon c pass was not involved in the landslide, and do less some salmon have been bred and have reent the river also in the "dead" years. But to intents and purposes the Verdal was a "dead" mon river until about 1920, since when it has a flourished.

Now a comparison of the two curves in F and Fig. 5 is very instructive. It does not show us the striking difference in a compar scale. But it also solves or elucidates one important problem. It clearly shows that the re for the enormous difference in the years 189 1920 must be the conditions in the river. Ar also forms one of the best experimental proofs, the salmon is a homing fish, returning to the where it has been bred. If this were not so, do the long years, when the river in the main unsuitable to the rearing of young fish, show an appalling lack of salmon? And if the sal were not homing, why don't the fish from total stock of Norway or fish from other ri enter and refill the depleted Verdal?

As a last example we will now compare total yield (Fig. 1) with a representation of yield of the mighty river T a n a, the longest the most yielding of all the salmon rivers of way. As in the case of the Lærdal we find Tana to have a possibly even better trend of yield than the total curve for the country sh Certainly a most useful and satisfactory compar which clearly shows, that whatever has happ to the salmon fisheries of Norway, and what has happened in other rivers, the Tana has suffered. The vastness and the primitive fishin this sparsely populated region may be account for the good and stabile conditions in the Tana

[1]) K. D a h l & S. S ø m m e. Salmon Marking in No 1938, 1939 and 1940. Skr. Norske Vidensk. Ak. Oslo, kl. 10, 1941.


1880
1890
1900
1910
1920
1930
100 %
50
Fig. 1. Total Yield.
Fig. 2. Mandal River.
Fig. 3. Fede River.
Fig. 4. Lærdal River.
Salmon on rod only
Fig. 5. Verdal River.
Land-slide
Fig. 6. Tana River.

But still the problem rises: could not the yield of the Tana even be improved?

We have given these few examples in order to illustrate some of the useful aspects of the method; but we are also inclined to point out that the same principle of treating curves for comparison might with advantage be employed for other statistics on varying quantities, where the object is to compare the rate of variation in various cases independent of the absolute magnitude of the quantities.

As in all statistics the present method of treatment will not be able to solve the problem as to the causes of the variation, it may only be instrumental in raising them.

Whaling Committee.

The Effect of Whaling on the Stock of Whales in the Antarctic.

By

Johan T. Ruud.

WITH our knowledge of the reproduction in whales it is possible to estimate the maximum recruitment of the stock and the method of age determination by counting *corpora lutea* in the ovaries, introduced by Mackintosh and Wheeler (1), the age composition of the stocks of mature females can be found and the total mortality (natural mortality and the effect of whaling) calculated.

This way of approach to the problem has been followed in two papers issued in *Discovery Reports*, the first by Wheeler (2) discussing the effect of whaling on the stock of fin whales at South Georgia, the next by Laurie (3) dealing with the stock of blue whales.

The applicability of the countings of *corpora lutea* as a method of age determination depends, however, on the accurate determination of the number of *corpora lutea* formed in each reproductive period, and with regard to this number the results arrived at by Peters (4) differ somewhat from those previously obtained. So far therefore, this question has not been finally solved.

Further, in order to use the method it is necessary to postulate a definite age at which sexual maturity is reached (2 years) as well as a known number of years (2?) between pregnancies.

The conclusions drawn by Wheeler and Laurie, therefore, cannot be taken as valid with regard to the actual figures for the rates of recruitment and reduction. Their results which tend to show that the rate of recruitment is insufficient to maintain the stock at the present intensity of whaling, must be regarded as indicative of the state of the stocks in question.

Laurie also draws attention to the fact that the average length of the blue whale has fallen off year by year and that the percentage of immature whales in the catch has increased.

Since the publication of Laurie's paper more material of length measurements has accumulated. In *International Whaling Statistics*, XVI, (5), Table v, we find the calculated average lengths of blue, fin and humpback whales in the 10 seasons from 1929/30, and the graphic representation of these results, which are given as Fig. 1.

Thus, from the season 1931—32 to the season 1938—39, the average length of blue whales taken in Antarctic pelagic whaling decreased from 84·03 to 78·11 feet, whilst the corresponding decrease in fin whales was from 69·95 feet to 67·21 feet.

Even if we disregard the extraordinary season 1931/32, when only 5 expeditions were operating in the Antarctic, the decrease is more than 2 feet in the average length of blue whales and a little less than 2 feet in the fin whales.

By the international agreement of 1937 the size limit for blue whales was raised from 65 to 70 feet, resulting in an increase in the average length of this species from 77·49 feet in 1936—37 to 78·42 feet in the following season. Thus, a change in the catch of small whales has an immediate effect on the average size of the animals. The decrease in the average length of the whales during these ten seasons, therefore, is not caused solely by the growing scarcity of large (and old) animals; Hjort and his collaborators have repeatedly pointed out that it is due to a high degree to the increased relative catch of immature whales.

In *International Whaling Statistics*, XVI, Table y, the percentage of mature and immature whales killed in Antarctic pelagic whaling is given for the ten seasons from 1929—30, and the graphic representation of these figures is here reproduced as Fig. 2.

We must remind the reader that the grouping of the material into mature and immature animals

is based on the average lengths for attainment of sexual maturity, found by Mackintosh and Wheeler (1) and not according to the actual physiological state of the animals.

From the season 1931/32 to 1938/39 the percentage of immature blue whales in the total Antarctic catch increased from 8·14 to 30·83 while the percentage of immature fin whales during the same period increased from 12·09 to 21·14. The percentage of immature fin whales was above 30 in the seasons 1929/30 and 1930/31, when the majority of the fin whales were taken on the old whaling grounds in the Weddell Sea.

The percentage of immature humpback whales is very high in all seasons, varying from 31·08 to 54·59 in the last six seasons, thus showing a very high rate of reduction in this species.

This increase in the catch of immature whales in the last seasons is in itself a serious sign of the depletion of the stock, as it is most certainly due to the increased intensity of whaling. The growing scarcity of large animals apparently leaves the gunners no opportunity of choice.

Table 1.

Average lengths in Engl. feet. Mature animals.

Season	Blue Whales		Fin Whales	
	♀	♂	♀	♂
1930—31	84·0	80·3	71·6	68·4
1932—33	84·4	80·2	71·4	68·2
1933—34	84·5	80·2	72·0	68·4
1934—35	84·6	80·2	71·6	68·1
1935—36	84·0	79·6	71·7	67·7
1936—37	83·8	79·5	71·8	67·7
1937—38	83·9	79·6	71·8	67·7
1938—39	83·5	79·6	71·7	67·7

The regulations imposed upon the industry in recent years regarding the taking of whales of minimum lengths have the effect that the catch cannot by any means be considered as a representative sample of the stock in the sea, although the changes in the size composition of the catch, as demonstrated above, must be a valid proof that similar changes have taken place in the stock itself.

The catch of mature animals is unaffected by the minimum lengths, and we can therefore with a high degree of exactitude consider the catch of mature whales as representative of the stock of mature animals present in the field.

In *Hvalrådets Skrifter*, No. 25, p. 29 (6), the calculated average lengths of mature animals, males and females separately, are given for the seasons 1930—31 to 1938—39. The figures, which are reprinted here as Table 1, show a slight but general decrease, particularly since the season 1933—34.

Assuming that the largest whales are on an average the oldest, we may take this decrease in the average lengths as an expression of reduced

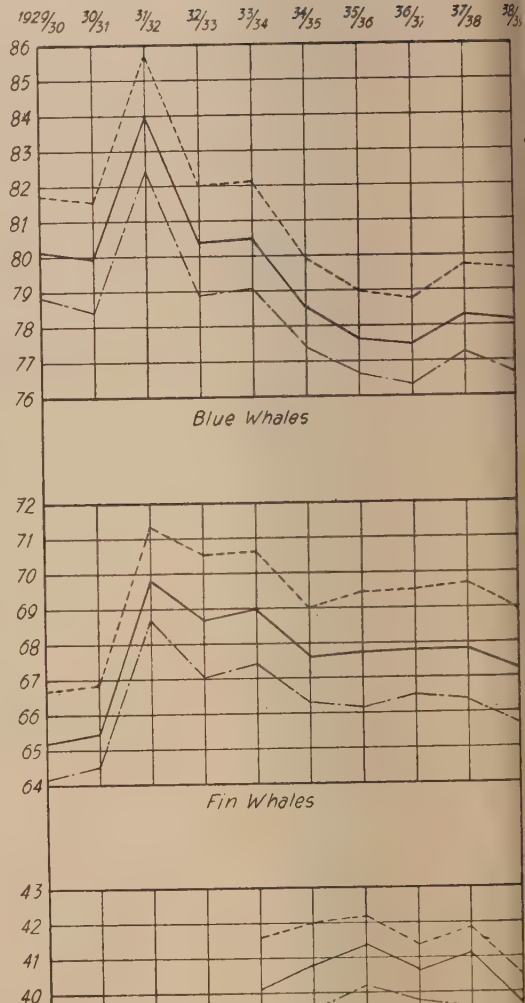


Fig. 1. Antarctic Pelagic Whaling. Average Size of Whales killed in Seasons 1929/30 — 1938/39.
Males: ——·——·—— Females. — — — —
Total Animals: ————
(From: Internat. Whaling Statistics, XVI, Graph 9, p. 4

ge age in the adult stock. The fact that the ease is so slight, however, is in accordance with xperience that size is no good indicator of the in whales after sexual maturity is reached.

o far the material presented above demonstrates the average size and age of the whales taken he Antarctic has declined pointing to the lusion that the rate of reduction in the stocks o high that the stocks are decreasing, the blue le stock in particular.

This conclusion is supported by other changes he composition of the catch.

With the growing scarcity of blue whales in field the gunner has to be satisfied with the h of less valuable species, preferably the fin le. Thus the composition of the catch with ard to species has changed during the last sons. From the total figures given in *International Whaling Statistics* we have calculated the ative catch of blue, fin and other whales as centages of the total catch, and the results are wn in Table 2.

The relative catch of blue whales increased up the season 1931—32, that is as long as the lustry was finding new fields with an unexploited k of whales in the Bouvet and Kerguelen regions, t as soon as the entire stock of whales in the tarctic had been laid under contribution the lative importance of the blue whales in the catch creased more or less regularly, while the catch fin whales increased correspondingly.

In fishery research the effect of fishing operations the stock can be studied with advantage by a tistical survey of the landings per unit of gear d effort. It is obvious that whaling and fishing

Table 2.

Blue, Fin and other Whales as Percentages of the Total Catch in Antarctic Pelagic Whaling.

Season	Blue Whales	Fin Whales	Other Whales
1929—30	66·5	33·2	0·3
1930—31	76·2	22·6	1·2
1931—32	82·2	15·4	2·4
1932—33	80·0	19·0	1·0
1933—34	71·0	23·1	5·9
1934—35	52·8	38·6	8·6
1935—36	56·6	31·4	12·0
1936—37	43·2	40·5	16·3
1937—38	33·6	60·0	6·4
1938—39	37·8	53·1	9·1

operations are very different. In fishing operations the effort can be easily expressed in "number of hours trawling" or in number of lines and hooks used and so on. In whaling operations the result depends, apart from the number of whales present, in a higher degree than in fishery, on the skill of the gunner, and on the size and power of the catcher. We may, however, base our calculations on the "average whale boat", including all factors affecting the efficiency of the boat.

This conception is more or less consciously present when for purpose of comparison we calculate the number of whales per boat taken by the different expeditions, or taken in the several seasons. Hjort, Jahn and Ottestad (7) have drawn attention to the fact that the yield per boat is a useful figure by which the productivity of a whaling ground can be estimated. This holds good

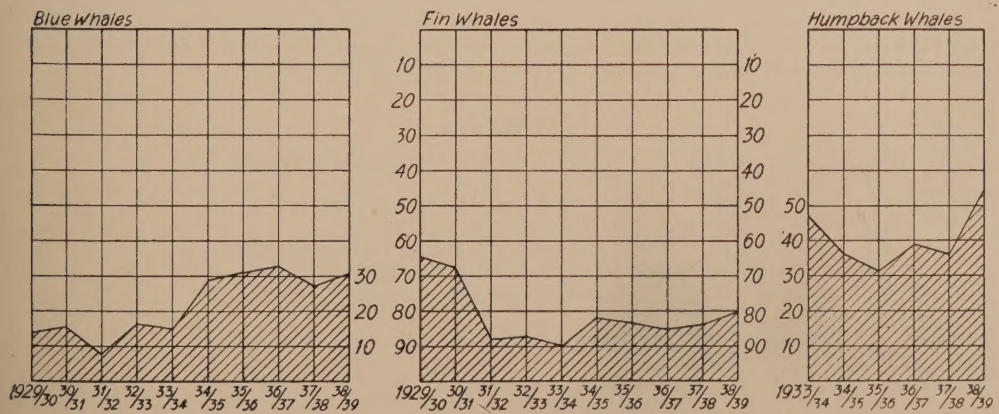


Fig. 2. Pelagic Whaling. The Percentage Proportion between Mature and Immature Whales, killed in the Seasons 1929/30 — 1938/39.

Mature Whales: blank area, scale to be read downwards.
Immature Whales: shaded area, scale to be read upwards.

(From: Internat. Whaling Statistics, XVI, Graph 12, p. 49.)

as long as the season is of the same duration and determined by natural conditions. As soon as the duration of the season is determined by regulations, differing from season to season or over periods of seasons, the yield per catcher per season loses its comparative value. For this reason the yield per catcher per day, called "a catcher's day's work" has been introduced in the papers on whaling, published in *Hvalrådets Skrifter*.

It will be easily understood that under the same conditions of whaling, i.e., with the same catchers and gunners and average weather conditions the yield will decrease if the stock of whales decreases. So far the yield per catcher's day's work will reflect the changes taking place in the stock. In recent years, however, the efficiency of the catchers has steadily increased. Even if we assume that the skill of the "average gunner" is unchanged, the size and power of the boats have been subject to considerable improvement. Furthermore, the effort put forward by the individual gunner has increased. This is due to the fact that in previous seasons, when whales were abundant, the operations of the catchers had to be restricted, as the productive capacity of the factory was limited. In recent seasons such restrictions on the catchers' activity have been made unnecessary owing to the scarcity of whales, although the number of catchers attached to the factories has been increased.

In comparing the yield per catcher's day's work from season to season this development must be borne in mind.

The decrease in the yield per catcher's day's work which should follow the decrease in the stock of whales, will therefore more or less be balanced by the increase in efficiency and effort of the catchers.

In Table 3 is shown the calculated yield per catcher's day's work in the Antarctic pelagic whaling, the material for these calculations has been derived from *International Whaling Statistics*, XVI.

Table 3.

The Yield per Catcher's Day's Work in the Antarctic Pelagic Whaling.

Season	Blue Whales	Fin Whales	Other Whales	Barrel of Oi
1929—30	0·68	0·32	0·03	90·1
1930—31	0·84	0·26	0·02	100·4
1931—32	1·18	0·22	0·03	133·3
1932—33	1·12	0·27	0·02	144·2
1933—34	1·23	0·40	0·10	163·0
1934—35	0·89	0·65	0·15	128·9
1935—36	1·03	0·57	0·22	141·2
1936—37	0·80	0·75	0·30	142·3
1937—38	0·60	1·07	0·12	129·3
1938—39	0·52	0·75	0·13	98·2

This table shows that the figures for blue wha and barrels of oil per catcher's day's work increas up to the season 1933/34. This was due partly the increase in the catchers efficiency, but chiefly the fact that the major part of the catch was tak in the new fields in the Bouvet and Kergue regions where blue whales were abundant in first seasons. From the season 1933/34 the creased relative catch of fin whales and immat blue whales is apparent and since that season yield of blue whales per catcher's day's work declined alarmingly. The yield in barrels of has decreased in the same period, although yield of fin whales has increased, thus pointing the fact that the stock of whales has fallen be a level which can be balanced by increased activit

As the catch of blue whales per catcher's da work is dependent on the number of whales pres in the field we may conclude that the stock of b whales has been reduced to such a degree that chance of catching a blue whale in 1938—39 less than half of what it was in 1933—34, in s of the increase in the effiency of the boat and activity of the gunner.

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